THE

ELECTRICAL REVIEW.

VOL. LXXVII. MAY 28, 1915. No. 1,957.

ELECTRICAL REVIEW.

Vol. LXXVII.] CONTENTS: May 28, 1915. [No. 1,957.

	Page
The Smithy Bridge Railway Collision	749
'Lest we Forget"	750
Arbitration in Municipal Contracts: Architect *v.* Engineer ...	750
Lead	751
"When in Rome——"	751
Some Notes on Shunt Regulating Resistances, by Thomas Carter (*illus.*)	752
The Pliotron in Wireless Telegraphy and Telephony (*illus.*)...	753
Notes from Canada...	755
Legal...	756
New Electrical Devices, Fittings and Plant (*illus.*)	756
War Items	757
Business Notes	758
Main-Motor-Starting Switchgear used on Modern German Submarines (*illus.*)	763
Notes	764
City Notes	767
Stocks and Shares	771
Share List of Electrical Companies	772
Market Quotations	772
A Motor Searchlight Plant (*illus.*)	773
Single and Multiple Ground-Wire Antennæ (*illus.*)	773
Electric Power in India, by H. R. Speyer	774
Load Factor, Output and Cost, by C. Ashmore Baker (*illus.*)	775
Correspondence—	
Cab Signalling	777
Cable Shortage	777
Automatic Lift Accidents (*illus.*)	777
Automatic Electric Lifts	778
Indian Notes	778
The Power Supply of the Central Mining-Rand Mines Group	779
The Bombay Hydro-Electric Scheme	780
New Patents Applied for, 1915	780
Abstracts of Published Specifications	780
Contractors' Column ... ... Advertisement page xx	

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE: 4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: Holborn 933; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, 19s. 6d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.

AUCKLAND, N.Z.: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31A, Strand Arcade, Queen Street.

BRISBANE: Gordon & Gotch, Queen St.

CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.

DUNEDIN, N.Z.: Gordon & Gotch, Princes Street.

JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c.: Central News Agency, Ltd.

LAUNCESTON: Gordon & Gotch, Cimitiere Street.

MELBOURNE: The Mining & Engineering Review, 90, William Street; Gordon & Gotch, Queen Street.

MILAN: Fratelli Trèves.

NEW YORK: D. Van Nostrand, 25, Park Place.

PARIS: Boyveau & Chevillet, 22, Rue de la Banque.

PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Loescher & Co., Corso Umberto 1° 307.

SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.

TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE UNIVERSAL ELECTRICAL DIRECTORY

(J. A. Berly's).

1915 EDITION

NOW READY.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C

THE SMITHY BRIDGE RAILWAY COLLISION.

THE report of Lieut.-Colonel Druitt on the collision on the Lancashire and Yorkshire Railway at Smithy Bridge on March 18th shows that, whilst the accident was generally similar to that at Ilford on January 1st, it yet had some features in which it differed from the earlier occurrence. The collision was, fortunately, not attended by so great a loss of life as that at Ilford, but one of those killed was the driver of the express, who seems to have been responsible for the disaster.

The collision took place during a snowstorm, as to the intensity of which, and the necessity for change of procedure in signalling operations, there seems at the time to have been some diversity of opinion amongst those engaged in working the traffic. The evidence given at the inquiry covers the working over four block sections and some of the operations at another, and clearly brings out several interesting points—not necessarily for the first time.

The train which was run into was an empty stock train, which had been standing at Smithy Bridge East box for over twenty minutes at the time of the collision. The fireman had complied with the regulation which required him to proceed to the signal box. The driver and fireman of this train both said they had difficulty in seeing the signals when approaching the point at which the train ultimately stopped. The light of one signal could not be seen on account of the spectacle being blocked with snow, and that signal was treated as at danger. Much of the difficulty in seeing the signals was due to the engine cab windows being covered with snow, which necessitated looking outside the cab to see the signals.

The first evidence with regard to the express, in the order of the progress of the train, is that of the guard in charge, who stated that he noticed the outer distant signal for Summit West was off when he passed it. The signalman at Summit West box said there was some delay in accepting the train by Littleborough Station, and that the express passed his box before he could remove his hand from the lever operating the outer distant signal. He was of the opinion from the speed at which the train was travelling that it would have passed all his signals at danger, had he not lowered them immediately before the train passed them. This signalman also stated that the windows of his box on the side from which the train was approaching were covered with snow. The outer distant, however, is some distance inside the tunnel and not, therefore, affected by the snow.

The fireman of the express stated that he saw the home signal for this box, and that it was off.

The signalman at Littleborough Station stated that the express passed through the section controlled by this box with the signals all off, but that he noticed that the distant signals for the box in advance (Littleborough West) were at danger, and he was so impressed by the speed of the train that he called the attention of the signalman in advance, and told him he thought the express was going to run past the latter's stop signals.

The fireman of the express stated that he advised the driver that the Littleborough Station distant was off, and the driver answered: "Right."

The express did pass the stop signals at danger at Littleborough West, and continued into the next section. The signalman at that box had a special lever for placing a detonator on the line run over by the express, but did not use it. He admitted that it "would have been better" if he had placed the detonator on the line when the section ahead was blocked, and if he had used "fog block," it would have added to the safety of the working.

The next direct evidence is again that of the fireman, who said: "I . . . . had just finished firing when my mate shut the regulator and applied the brake, but did not say anything to me." "My driver appeared to be all right and had not shown any signs of illness. I think he was looking out over the side of the cab before the collision occurred. . . . The windows of the cab were snowed over, and when I observed the signals I was looking outside the cab."

Here we have a number of conditions contributing to the accident, and some of them in more ways than one. A snowstorm of some magnitude blocks the line with traffic between certain places. A train is held up at a place already so choked with traffic that it is impossible to get the train off the main line. Some of the signalmen fail to realise all the conditions, and do not bring into operation the modifications of block working which are intended to meet the conditions set up by the snowstorm, and one of them fails, although specially warned, to actuate emergency mechanism, provided to deal with overrunning. The driver of the train following that which has been brought to a stand overruns all the signals in one section and the non-stop signals of the section occupied by the standing train, with the known results.

Three points seem to stand out clearly from this short recital of the circumstances in the order of their occurrence. The first is that the value of any apparatus provided for manual operation in cases of emergency depends entirely upon the readiness with which the circumstances are grasped by the operator. The second is that it seems undesirable to leave the initiative for bringing modifications of operation into use in the hands of those whose instructions for the purpose are dependent upon their local conditions. The third is the necessity for further information being afforded to the driver under such conditions as obtained in this case.

The first point relates to the emergency detonator placer at Littleborough West, which is said to be one of a large number installed. In this case infrequency of use had apparently a good deal to do with the failure to operate it when such operation would have been of peculiar value. The second point refers to the conditions under which signalmen are to commence fog-block working and to call out fog-signalmen. Fog signalmen are called out when the signalman cannot see, or has difficulty in seeing, some designated "object" in his neighbourhood from his box. The degree of clearness with which the signalman can see his "object," and upon which he must decide upon the need for fog-signalmen, is obviously a matter personal to individual signalmen, and is governed, moreover, by local conditions. But this measure of visibility tells the signalman nothing with regard to the effects of the storm on the driver of an approaching train, such as the covering of the engine-cab windows, as in this case, nor does it tell him anything with regard to the obscuring of the lights of signals on the indicating side of those signals which lie in the direction from which trains approach his box. After all, it is the effects in so far as they relate to the driver that count.

On the third point it seems hardly necessary to enlarge. There are few who at this date will not concede that the driver's duties are of too onerous a character under such conditions, without means of ascertaining the positions of signals in addition to that of direct vision. The evidence of the driver and fireman of the stock train and that of the fireman of the express shows clearly the difficulties experienced in sighting the signals. The evidence goes to show that the express driver's condition was normal. What caused him to pay no observance to the signals exhibited in the comparatively short run necessary to bring about the collision will never be known, but the lesson—one of many of the same class—is clear.

Colonel Druitt concludes the report in much the same terms as Colonel von Donop concluded the report on the Ilford collision. Both would seem to be content with "an unmistakable warning as to the position of the distant signal." Both refer to other railway companies (not by name) which have already made trials of devices designed for this purpose, and the further remarks are only diversified because the L. and Y. Co. have made experiments with "more than one kind for warning drivers when passing distant signals," and the Great Eastern have not. One is led to infer from the almost identical phrasing of the concluding paragraphs of the two reports that the Inspectors have come to an agreement with regard to the requirements. But surely the paragraphs quoted do not represent all that the Inspectors consider necessary?

"Lest we Forget."

The frightful disaster which took place near Carlisle on Saturday last, far surpassing in magnitude and horror any railway accident previously recorded in Europe or America, has sent a thrill of grief and dismay throughout the nation. The saddest feature of the accident is the fact that not only its appalling accompaniments, but also its very occurrence might have been prevented. The use of electric signals giving warning to the driver of the troop train of the presence of the local train on the up line would have enabled him to stop in time, and as our pages have fully shown, the only question is not whether there is a practical system of track-circuiting available, but which of the various systems extant is the best. As for the burning of the trains, there is only too much reason to believe that it was due to the use of gas on two at least of the three trains that were involved. We almost despair of arousing the British public to the realisation of the dangers of this practice. We have constantly dwelt upon the terrible risk incurred by it, though abused by the organs of the gas industry and mocked at by our electrical contemporaries, and we have urged that the bitter lessons taught us from time to time should not be forgotten, but should be taken to heart and acted upon. Unfortunately the public has a short memory, and after a few days' agitation takes up some other sensation. We fear that the war news will occupy its mind to the exclusion of all else, and that the railway authorities will be permitted as usual to ignore the teachings of the past.

Arbitration in Municipal Contracts: Architect v. Engineer.

The Melbourne City Council recently discussed a motion in which it was suggested that the arbitration clauses contained in the conditions of contract framed by the Royal Victorian Institute of Architects should be inserted in all contracts to be entered into by the Council to which such clauses would apply. The notice of motion rightly brought a communication from the Victorian Institute of Engineers pointing out several important things. First, it was asserted that by far the greater proportion of the Council's contracts related to matters of civil, mechanical, and electrical engineering. Next, that a large proportion of the items of building contracts also related to engineering issues in respect of steel and reinforced concrete construction. Lastly, and by no means least important, it was remarked that the conditions of contract of the Royal Victorian Institute of Architects required that arbitrators should be members of that Institute. The engineering profession not unnaturally protested against any attempt to prevent its members from acting in a capacity in which it had previously been recognised that they were fully entitled to act. Objection was with equal justice raised on the

ground that the motion, if passed, would make no provision whatever for arbitration in respect of a large class of work concerning which engineers alone were competent to act. In the course of the City Council discussion it transpired that the Master Builders' Association had resolved not to tender for any of the Council's contracts unless there was an independent arbitrator to appeal to, and the suggestion referred to in the motion was based on the belief that members of the Institute of Architects had had the largest experience of arbitration matters. That an independent arbitrator should be appointed is altogether the correct thing—we have advocated it in season and out of season for many years—but to imagine that because an architect is a member of a certain Institute he is therefore fully qualified to arbitrate upon more or less extensive engineering operations is, from the engineering point of view at any rate, little short of ludicrous. We should more readily regard a highly qualified professional engineer as being by training and experience fitted to arbitrate in regard to the contracts concerning which the architect had been acting. However, the original proposal appears to have been brought forward with the most innocent of motives, under pressure of the Builders' Association, as competitive tenders could not be obtained without independent arbitration being secured, and the points advanced by the Victorian Institute of Engineers had seemingly not been foreseen. The upshot of the matter was the withdrawal of the original motion and the substitution of an amendment which would avoid the principle proposed being applied to every department dealing with contracts. The amendment which was agreed to contented itself with requesting the Legislative Committee of the Council to revise the conditions of contract, with the special object of providing for an arbitration clause. There the matter ends for the present, but the incident shows how necessary it is for engineering organisations to be on the alert, watching for opportunities to safeguard the interests of their members, and how timely interventions to that end may be successful in preventing undigested and misunderstood propositions from being adopted which, if permitted to pass, could only lead to a state of things most unsatisfactory for engineering contractors, and derogatory to the best interests of professional engineers.

Lead.

THERE have been heavy arrivals of lead during recent weeks, the total imports during April being 23,400 tons, making a total of about 81,000 tons compared with about 77,000 tons last year. There has been a large increase from Spain, nearly 5,000 tons, while the United States is 9,600 tons up, but the imports from Australia show a decrease of about 6,000 tons, and those from other countries of about 4,000 tons. Consumers in England, at all events, do not care much about American lead, and there have been a considerable number of complaints regarding some of the metal which has been delivered on the London market. It is generally complained that the metal does not roll well, and is not sufficiently pure to please the corroders, hence the general dissatisfaction which has been voiced in connection with deliveries of lead designed for use in these particular directions. This has accounted for an increased demand for Spanish and Australian brands, and as much as 10s. a ton premium has been paid for some of these during the past week or so.

There has been a moderate inquiry experienced in all directions, but the general consuming trade is admittedly rather quiet. There is still considerable faith felt in the development of large demands for the Allies, but, so far, they have not reached an important level just lately, though it is thought the indications point to an improvement before long. America has rather been holding back from the market lately, in consequence, no doubt, of the fall in prices which has been sustained, but an advance in London would, no doubt, induce sellers to come forward with much more freedom.

There will probably be no material increase in the world's production of lead in the near future, and if this proves to be the case, demands may be fully able to take care of the supplies. Many people, indeed, think it possible that the whole of the available material may be swept up by consumers before long, and if this should be the case, an advance in prices would be inevitable.

"When in Rome —."

WE suppose there are few words of foreign trade counsel that have been so frequently reiterated in the ears of the British manufacturer as those which urge the necessity for studying the peculiar characteristics of markets in which our foreign competitors have been successful, and we have not. Sometimes it has seemed to be little short of a heinous offence to dare to say such things. Yet that such advice has not been proffered without abundant justification is being proved in many directions in these days of war. It is true that most of our engineering factories are engaged to the extent of a considerable percentage of their productive capacity upon war requirements, but it is equally true, as the Chancellor of the Exchequer has so recently told us, that it is of vital financial importance to the nation that we maintain our exporting activities. The great volume of our trade must be kept flowing as far as labour and transport and shipping facilities will permit. The amount of business actually available is large, and it is to be hoped that we shall be able to cope with it notwithstanding the increasing calls for recruits for the fighting line. But the fact that there is business doing does not allow us to shut our eyes to the need for preparations for the future. We have said so much on this matter that we hardly like to touch it again so soon, but it is imperative that we should give heed to these oft-repeated words of counsel, which are now being used by those who are anxious to do business with us. We have secured for ourselves an unenviable reputation in too many countries for assuming a high and mighty independent attitude toward those with whom we affect to desire to open business connections. We are prepared to offer for sale the things that we make but are charged with being too ready to turn down requests for articles that are out of our usual run of manufactures—things that in many cases might well be made in British factories. We believe that that habit is changing, and that it will have to undergo further development in the coming days. But for some markets, perhaps, that "take it or leave it attitude" has not been so serious an obstacle to our success as our failure to understand the people with whom we desire to trade, and their systems of doing business.

In Russia, we read, British trading authorities have been dwelling upon the necessity for our traders adapting themselves to the system of credit that obtains there. This is, of course, not a new point, but it is one of prime importance.

One of these authorities says that English people have not hesitated to confess their ignorance of the Russian system, and to admit that in that ignorance lay the reason of their inability to comply with many of the requirements of Russian commercial men. Long credit and easy credit are stated to be essential, and German firms have noted that circumstance, and by meeting the position strengthened their hold. "The Teutons had a whole army of *commis voyageurs* who captured hosts of clients by studying the customs of Russian traders and conforming with the credit system." M. Timiriazeff, whose name is quite familiar to our trade readers, says (*Financial Times*): "I am certainly not one who states that all is good in our Russian methods, but still I must say that the most dangerous competitors of Great Britain, the Germans, always understood how to adapt themselves to existing conditions, and as a consequence they got together an important trade." We have frequently shown how German firms have practically flooded with commercial travellers, efficiently trained and capable men, markets which we have left to the care of a handful of men. It is easy to see that our rivals have been better able to meet the requirements of markets when their numerous representatives have so thoroughly studied the people, their systems and their general conditions. The warning may be familiar, but it is none the less necessary and none the less timely on that account.

SOME NOTES ON SHUNT REGULATING RESISTANCES.

By THOMAS CARTER.

(*Continued from page* 717.)

II. *Regulators with Protective Resistances.*—These are used probably less frequently than potentiometer regulators, but they are equally interesting from a theoretical point of view, and are capable of a similar general treatment in terms of E/s and multiples of s.

The standard connections of a regulator of this type are shown in fig. 3.

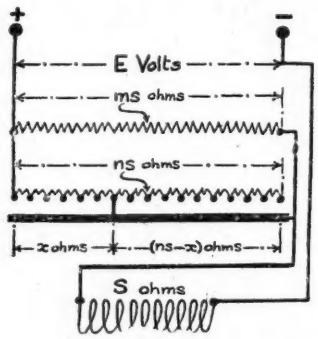


FIG. 3.

The exciting voltage, E, has across it the field winding, whose resistance is s, in series with a loop consisting of the protective resistance, $m\,s$, in parallel with x, which is part of the regulator, $n\,s$.

The total resistance between terminals is—

$$s + \frac{m\,s\,q\,n\,s}{m\,s + q\,n\,s}$$

$$= s\,.\,q\,n/(m + q\,n)\,.\,(m + 1 + m/q\,n).$$

The total current in the circuit, which is the current in s, *i.e.*, the field current, is—

$$\mathrm{E}/s\,.\,(m + q\,n)/q\,n\,.\,1/(m + 1 + m/q\,n).$$

The current in x is $m\,s/(m\,s + x) = m/(m + q\,n)$ of the total current, and the current in $m\,s$ is $x/(m\,s + x) = q\,n/(m + q\,n)$ of the total, so that—

$$\frac{\mathrm{E}}{s}\cdot\frac{m}{q\,n}\cdot\frac{1}{m + 1 + m/q\,n}$$ is the current in x,

and $$\frac{\mathrm{E}}{s}\cdot\frac{1}{m + 1 + m/q\,n}$$ is the current in $m\,s$.

A tabular statement can now be made as follows, showing the varying values of the currents in the three parts of the circuit, with m and n as yet indeterminate, for values of x from zero to $n\,s$, *i.e.*, for values of q from zero to unity.

$x = q\,n\,s$.	Current in $m\,s$ (protective resistance)	Current in x (regulator).	Current in s = field current.
0	0	E/s	E/s
·1 $n\,s$	E/s . 1/(m+1+m/·1n)	E/s . m/·1n(m+1+m/·1n)	E/s . (m+·1n)/·1n(m+1+m/·1n)
·2 $n\,s$	E/s . 1/(m+1+m/·2n)	E/s . m/·2n(m+1+m/·2n)	E/s . (m+·2n)/·2n(m+1+m/·2n)
·3 $n\,s$	E/s . 1/(m+1+m/·3n)	E/s . m/·3n(m+1+m/·3n)	E/s . (m+·3n)/·3n(m+1+m/·3n)
·4 $n\,s$	E/s . 1/(m+1+m/·4n)	E/s . m/·4n(m+1+m/·4n)	E/s . (m+·4n)/·4n(m+1+m/·4n)
·5 $n\,s$	E/s . 1/(m+1+m/·5n)	E/s . m/·5n(m+1+m/·5n)	E/s . (m+·5n)/·5n(m+1+m/·5n)
·6 $n\,s$	E/s . 1/(m+1+m/·6n)	E/s . m/·6n(m+1+m/·6n)	E/s . (m+·6n)/·6n(m+1+m/·6n)
·7 $n\,s$	E/s . 1/(m+1+m/·7n)	E/s . m/·7n(m+1+m/·7n)	E/s . (m+·7n)/·7n(m+1+m/·7n)
·8 $n\,s$	E/s . 1/(m+1+m/·8n)	E/s . m/·8n(m+1+m/·8n)	E/s . (m+·8n)/·8n(m+1+m/·8n)
·9 $n\,s$	E/s . 1/(m+1+m/·9n)	E/s . m/·9n(m+1+m/·9n)	E/s . (m+·9n)/·9n(m+1+m/·9n)
1·0 $n\,s$	E/s . 1/(m+1+m/n)	E/s . m/n(m+1+m/n)	E/s . (m+n)/n(m+1+m/n)

This type of regulator, in contrast to the potentiometer type, which is capable of giving zero field current, is useful in cases where the ratio of maximum to minimum values of shunt current is not abnormally great. Let this ratio be p. The value of p clearly depends on experimental data, and is not arbitrary. The values of m and n are, however, arbitrary, but they are connected with each other in a definite way, according to the value of p. For it is evident from the last column of the table that—

$$p = n/(m + 1 + m/n)/(m + n)$$
$$= (m\,n + n + m)/(m + n)\,;$$

or, $p - 1 = m\,n/(m + n)$.

This can be transformed into—

$$\{m - (p - 1)\}\{n - (p - 1)\} = (p - 1)^2,$$

which is a rectangular hyperbola, with asymptotes $m = p - 1$ and $n = p - 1$.

Just as the value of n was the starting point for the potentiometer regulator curves, so the value of p is the starting point for the curves for regulators with protective resistances; and a set of curves for various values of p, with possibly one or two different pairs of connected values of m and n for the same value of p, if found useful, may be drawn. Fig. 4 shows the curve connecting m and n

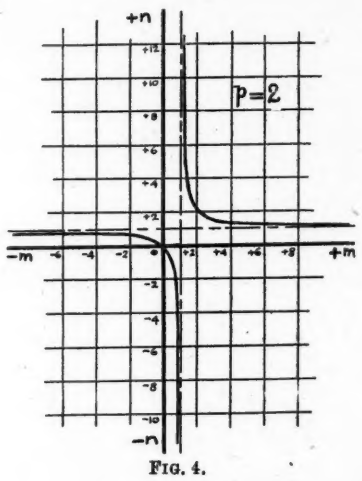


FIG. 4.

for the value $p = 2$. The whole curve is drawn, including negative values, which are not usable for the present purpose, but are given to show the full shape of the curve. The asymptotes are $m = 1$ and $n = 1$, and the only part of the curve practically useful is the part close to the right of the vertical asymptote with values of m just over 1·0, and fairly high values of n. In other curves, the practically interesting part would be where m is just greater than $p - 1$, whatever be the value of p. The reason for making m just greater than $p - 1$ is to make it fulfil the condition that should the regulator become damaged, and its circuit be broken, the protective resistance will not reduce the field current much below its normal minimum value. The protective resistance is alone in series with the field winding under such circumstances, and if m is nearly equal to $p - 1$,

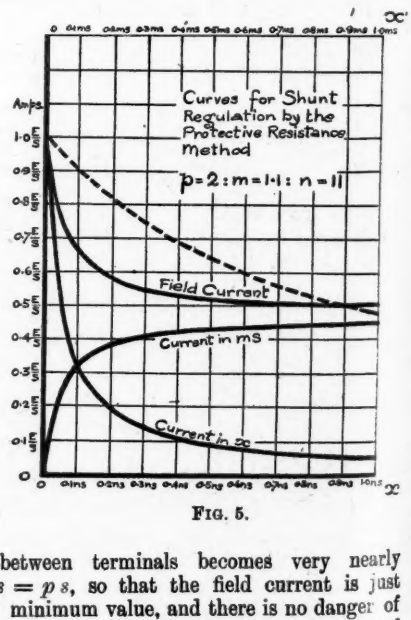


FIG. 5.

the resistance between terminals becomes very nearly $(p - 1)\,s + s = p\,s$, so that the field current is just under its usual minimum value, and there is no danger of an abnormal reduction of volts in a dynamo or increase of speed in a motor.

For the present case, $(m - 1)\,(n - 1) = 1$, or $m\,n - m - n = 0$, or $n = m/(m - 1)$;

i.e., if $m = 1{\cdot}00 - 1{\cdot}02 - 1{\cdot}04 - 1{\cdot}06 - 1{\cdot}08 - 1{\cdot}10$,
$n = \infty - 51 - 26 - 17{\cdot}7 - 13{\cdot}5 - 11{\cdot}0$.

Choose the pair of values $m = 1{\cdot}1$ and $n = 11$, and plot the curves shown in fig. 5, in which, as in Section I, ordinates represent currents in terms of e/s, and abscissæ represent values of x for $q = 0$ up to $q = 1{\cdot}0$. These curves are typical of the whole set which can be plotted for various values of p. Experience again will show the most suitable values of m and n for a given value of p; but the curves, once plotted, are of universal application, as has already been explained in the previous section. The determination of the current capacity and resistance of successive steps in the regulator is carried out on a similar principle to that already described for potentiometer regulators.

The higher values of p will occur in the case of motors with large speed ranges, and particularly in those with an appreciable amount of series winding on the field in addition to the shunt winding, it being necessary in certain cases to use compound-wound motors with a speed range of fairly large amount. After a certain value of p is reached, depending on the energy to be dealt with in the regulator, and other practical considerations, it becomes no longer suitable to use a regulator of this type or the ordinary type, and it is necessary to go over to the potentiometer type already described. No general rule is available for the correct point of change-over: experience, again, is the only guide.

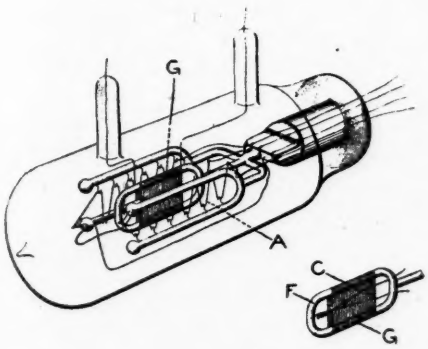
If, as is indicated in the earlier article already referred to, the protective resistance has to be used for shunt regulation as an ordinary series type regulator in case of emergency, should the regulator become broken, the current it carries will be the whole field current, as there explained. The curve of field current in this case is quite different from the curve indicating normal conditions. The latter is shown by a full line curve in fig. 5, plotted, as are the other two full-line curves, against the lower scale of $x = 0 - 1{\cdot}0$ *n s*. The field current curve, and therefore also the curve of current in *m s* for the abnormal condition, is shown by a dotted line, and is plotted against the upper scale of $x' = 0 - 1{\cdot}0$ *m s*, indicating the variation in current as more or less of *m s* is cut out in the special case under consideration. If, then, the protective resistance has to fulfil this emergency function, it must have a capacity equal to the dotted curve in its various sections, according to the way in which these can be temporarily short-circuited, and not merely equal to the maximum value indicated in the full-line curve. This shows the actual amount of the increase in size indicated in the earlier article. The dotted curve also clearly shows by how small an amount the minimum shunt current is reduced should the regulator be out of action,

(To be concluded.)

THE PLIOTRON IN WIRELESS TELEGRAPHY AND TELEPHONY.

A further application of the thermionic current by the Research Laboratory of the General Electric Co., U.S.A., is described in the current issue of the *General Electric Review*, by Dr. Irving Langmuir, who, we believe, has conducted the researches on this subject.

After outlining the history and fundamental principles of the emission of electrons from heated metals *in vacuo*, and briefly describing the kenotron (see Elec. Rev., May 7th, 1915), the author states that in a pure electron discharge, as the temperature of the filament is raised, a point is always reached where the current becomes limited by the space charge between the electrodes. Under these conditions, only a small fraction of the electrons escaping from the cathode reach the anode, whereas the majority of them are repelled by the electrons in the space, and therefore return to and are absorbed by the cathode. From this viewpoint it is evident that if a negatively charged body is brought into the space between the anode and cathode, the number of electrons which then return to the cathode will increase, so that the current to the anode will decrease. On the other hand, if a positively charged body is brought near the cathode, it will largely neutralise the negative charges on the electrons in the space and will therefore allow a larger current to flow from the cathode. In this way it is possible to control the current flowing between the anode and cathode by an electrostatic potential on any body placed in proximity to the two electrodes. This controlling effect may be best attained by having this controlling member in the form of a fine wire mesh, or grid, placed between the electrodes.



A, anode; G, grid; C, cathode; F, frame.

Fig. 1.—Pliotron (Amplifier).

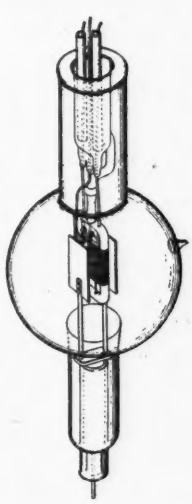


Fig. 2.—Pliotron (Controller).

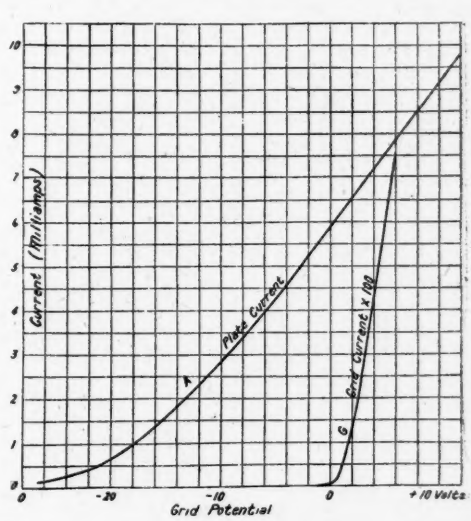


Fig. 3.

The term "Pliotron" has been adopted to designate a kenotron in which a third electrode has been added for the purpose of controlling the current flowing between the anode and cathode. This word is derived from the Greek "pleion" signifying "more." A Pliotron is thus an "instrument for giving more" or an amplifier.

The three elements, hot filament cathode, grid, and anode, are, of course, similar to the elements of the De Forest audion. However, the operation of the audion is in many ways quite different from that of the pure electron device operating in the way described above.

In the audion, as well as in the Lieben-Reisz relay, the amplifying action appears to be largely dependent upon gas ionisation, even when the device operates well below the point at which blue glow occurs. The action is probably somewhat as follows: there is normally present a small amount of gas ionisation, due to the passage of the electrons between cathode and anode. The presence of the positive ions partly neutralises the space charge which limits the current flowing between the electrodes. If a small positive potential is applied to the grid, the velocity of the electrons passing by it is somewhat increased, and they therefore produce more ions in the gas. Besides this, as the potential on the grid is increased, the number of electrons passing the grid is increased, and this again tends to increase the amount of ionisation. A very slight increase in the amount of ionisation brought about in this way very greatly reduces the space charge, and therefore largely increases the current that can flow between the electrodes. Thus, with a given construction of grid, filament, and plate, the relaying action may be very greatly increased beyond that which would occur if no gas were present. The amount of gas ionisation which is necessary, in order to eliminate practically completely the

effects of space charge, is often much too small to produce a visible glow in the gas.

If too much gas is present, or if the potential on the plate or the current flowing to the plate is too large, then the amount of positive ionisation may reach such values as almost entirely to neutralise the space charge and thus allow a large current to flow. Under these conditions, the relaying action of the audion is lost. This is the case, for example, when the audion gives a blue glow. In the border land between these two conditions, there is a region of instability in which the

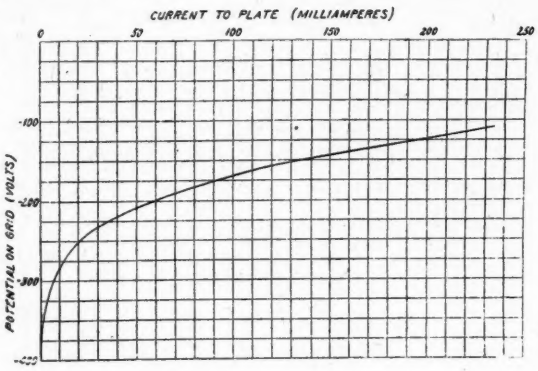


FIG. 4.

sensitiveness of the audion may be enormously great, but it is usually not found very practicable to operate the device in this region, because of the difficulties in maintaining adjustment, for any lack of adjustment may cause the audion to go over into a condition of blue glow.

The audion is often used with a condenser in series with the grid. Under these conditions, the audion requires the presence of a certain amount of gas ionisation so that the positive ions formed may prevent the accumulation of too large a negative potential on the grid. With the pliotron, owing to the absence of positive ions, if it is desired to use a condenser in series with the grid, this condenser must be shunted by a high resistance, and often a source of potential must be placed in series with the high resistance, in order to supply positive electricity to the grid as rapidly as this tends to be taken up from the electrons given off by the filament.

In the construction of pliotrons, it has been found desirable to make the wires constituting the grid of as small cross-section as possible. In this way, even when a positive potential is applied to the grid, the current that flows to the grid may be made extremely small. The use of very fine wire is made possible by using a frame of glass, metal or other suitable material, to support the grid. Thus, in figs. 1 and 2 the filament is mounted in the centre of a frame made of glass rods, on which the fine grid wire is wound by means of a lathe. The grid may thus consist of tungsten wires of a diameter as small as 0.01 mm., and these may be spaced as close as 100 turns per centimetre, or even more.

In figs. 1 and 2 are shown two types of pliotron. Fig. 1 shows a pliotron such as is used for amplifying radio-signals in a receiving station. Fig. 2 shows a large pliotron which may be used for controlling as much as 1 KW. for radio-telephony.

The characteristics of the pliotron depend upon the length of filament used, the distance between filament and grid, the spacing between the grid wires, the diameter of the grid wires, the distance between grid and anode, and the size and shape of the anode. The important elements in the characteristics of a pliotron are, first, the relation between the current flowing between anode and cathode as a function of the potential on the anode and of that on the grid; second, the current flowing to the grid, as a function of the potential of the grid and the potential of the anode.

Fig. 3 gives the characteristics of a small pliotron such as that shown in fig. 1. Curve A gives the current flowing to the anode for different grid potentials, while the potential of the anode is maintained constant at 220 volts. Curve G gives the current flowing to the grid under the same conditions. For different anode potentials, these curves are shifted vertically, by amounts proportional to the change in anode potential.

Fig. 4 gives similar characteristics for a large pliotron like that shown in fig. 2. In this case, the anode potential was 8,500 volts.

By using a fine grid, the current to the anode can be stopped entirely by even a very slight negative potential on the grid. On the other hand, a rather low positive potential will then be sufficient to draw a large current to the anode. The amount of current taken by the grid would be only a very small fraction of that flowing to the anode, in case the diameter of the grid wires is small compared to the distance between them. On the other hand, with a coarse grid—that is, a grid in which the spacing is large, a rather large negative potential may be necessary in order to stop the current flowing to the anode. Similar results to those obtained by changing the spacing of the anode may be obtained by changing the relative distances between the electrodes.

By using a fairly coarse grid, consisting of fine wire, it is possible to obtain a control of the current to the anode, always using a negative potential on the grid. Under these conditions, since there are no positive ions present, no current flows to the grid, except that necessary to charge it electrostatically to the required potential. It thus becomes possible to control very large amounts of energy in the anode circuit, by means of extremely minute quantities of energy in the grid circuit.

There does not seem to be any upper limit to the voltages that may be used in the pliotrons. With voltages over 30,000 it is often necessary to space the electrodes further apart and to use heavier wires for the grid, in order to reduce the danger of breakage of the parts by the large electrostatic forces which then occur.

The current-carrying capacity of the pliotron is limited only by the size of cathodes that it is found convenient to use and by the voltage available. Large currents cannot be readily obtained with low voltages because of the space charge effects described previously. With voltages above 500 volts, however, it is found practicable to use currents of 300 or 400 milliamperes for a pliotron of the type shown in fig. 2. With high potentials, there is no difficulty in using currents as large as this, provided the energy is consumed in some device in series with the pliotron. On the other hand, if the full voltage is applied to the anode while the current is flowing to the anode, the energy liberated in the form of heat may be so great as to volatilise the anode or cause it to radiate so much heat that the glass parts of the apparatus are softened. In a pliotron with a 5-in. bulb the amount of energy that may be so consumed within the pliotron is about 1 KW. Still larger amounts of power may be dissipated if the bulb is immersed in oil and if the grid frame is made of quartz, or other heat-resisting material.

It is evident from the characteristics of the pliotron that any number of these devices may be placed in parallel, and that in this way very large amounts of power may be controlled.

Pliotron as Wireless Detector.—If the antenna of a receiving set is coupled directly to the grid of a pliotron and a telephone receiver is placed in series with the anode, signals may be readily detected, but the results obtained in this way are usually very poor. Under these conditions, the sensitiveness of the arrangement is proportional to the curvature of the curve A, fig. 3 (or, more accurately, proportional to the second derivative of the anode current with respect to the grid potential). This curvature may be somewhat increased by applying a negative potential to the grid, but even under these conditions the sensitiveness of the arrangement is usually not very high.

If it is attempted to use a condenser in series with the grid and thus use the pliotron in the way that the audion is often used, it is found necessary to shunt the condenser with a resistance and often place a battery of a few volts in series with the resistance, in order to prevent a large negative charge from accumulating on the grid.

It has been found, however, by W. C. White, that a very minute trace of certain gases may very greatly increase the sensitiveness of this device as a detector. For example, by placing within the bulb a small quantity of an amalgam of mercury and silver, the characteristics of the tube show a kink, as indicated in fig. 5. With a detector of this sort, if

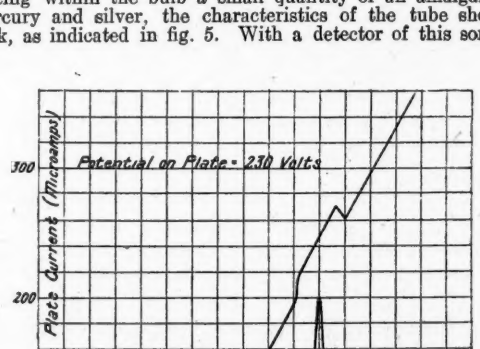


FIG. 5.

the grid potential is adjusted so that its average value is approximately that at which the kink occurs, there is a very marked increase in sensitiveness. This is due to the fact that under these conditions either an increase or a decrease in the grid potential causes a decrease in the anode current. The sensitiveness of this detector is then very high. The

quantities of mercury vapour necessary to give this effect are so low that anode voltages of 200 or more may be used without any indication of glow discharge.

Pliotron as Amplifier.—The value of a pliotron as an amplifier is dependent primarily upon the slope of the curve between anode current and grid potential; for example, curve A, fig. 3. A second factor of importance is the magnitude of the current taken by the grid. In order to get the greatest amplifying effect it is desirable to have this current as low as possible. In a pliotron of the type shown in fig. 1, the current to the anode increases at the rate of about 1 milliampere per volt change in the grid potential.

By using larger anode potentials, the slope of the curve can be made very much greater, since it becomes possible to use grids of finer mesh. For example, in fig. 4 it is seen that the slope of the curve corresponds to two milliamperes increase in anode current per volt change in grid potential.

It has been found that there is no sluggishness in the characteristics of the pliotron, even at the highest frequencies.

By connecting the pliotron as amplifier, as shown in fig. 6, the high-frequency currents received from the grid may be amplified from one hundred to six hundredfold. In this

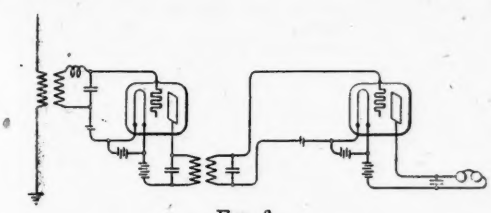


FIG. 6.

arrangement, it is the high frequency or radio-frequency that is amplified, and not the audio-frequency. This amplification of the radio-frequency possesses the marked advantage that the detector circuit may be tuned to the same frequency as the amplifier circuit, and in this way a very marked increase in selectivity is obtained. In fact, it has been shown by Mr. Alexanderson that the resonance curve of an outfit consisting of amplifier and detector, both tuned to the radio-frequency as shown in fig. 6, may be obtained from the resonance curve for the detector alone, by squaring the ordinates. For example, if with a single detector, the signals from one station (*A*) are received one hundred times as strong as those from another station (*B*), then, with the above arrangement with the amplifier, the signals from *A* will be received one hundred times squared, or ten thousand times as strong as those from station *B*. If two amplifiers be used in this way, the signals from station *A* can be obtained one million times as strong as those from station *B*.

In practice, this arrangement has been found to give a wonderfully high degree of selectivity.

Of course, a pliotron may also be used for amplifying the audio-frequency, coupling the circuits together by means of an iron core transformer. A single pliotron, under these conditions, gives an amplification of current of several hundred-fold, when voltages of from one to two hundred volts are used on the anode.

Pliotron as Oscillator.—By placing inductance and capacity in the grid and plate circuits and coupling these two circuits together, it is possible to use the pliotron as a source of continuous oscillations. Small pliotrons of the type shown in fig. 1 may produce oscillations up to a few watts, and these may be used in a receiving station, according to the Heterodyne principle, for receiving continuous oscillations. One pliotron may be used for both amplifying or detecting, and for producing oscillations.

With the larger pliotrons, using voltages of a few thousand volts, up to a kilowatt of high-frequency oscillations may readily be produced by a single tube.

Use of the Pliotron in Radio-Telephony.—By means of a single large pliotron, it has been found possible to control about two KW. of energy in an antenna, by means of the currents obtained from an ordinary telephone transmitter. There are many arrangements by which this may be accomplished. For example, a two-KW. Alexanderson alternator (100,000 cycles) may be loosely coupled to the antenna and the anode of the pliotron may be connected to a point on the antenna where the potential is normally high. As long as the potential on the grid of the pliotron is strongly negative, no current flows to the pliotron and, therefore, the full energy is radiated by the antenna. If, however, the negative potential on the grid is decreased, a sufficient current may be drawn from the antenna to strongly damp the oscillations, and thus greatly decrease the energy radiated. With sufficiently high potential on the grid, practically the whole of the energy may be diverted from the antenna.

It is thus possible to control the output of the antenna by varying the negative potential on the grid of the pliotron. Since the grid is always negative, no current flows between filament and grid, and therefore practically no energy is required to maintain the charge on the grid. In this way, therefore, by connecting the secondary of the transformer between the grid and filament, and placing the primary of the transformer in series with a telephone transmitter, it is possible, by means of the variations in the currents from the telephone transmitter, to obtain potentials on the grid of several hundred volts, and thus to control the output of the antenna.

Instead of using an arc or alternator as a source of high frequency current, the pliotron may also be used as generator of the oscillations. One pliotron may be used both for producing the oscillations and for controlling the amplitude of the oscillations, in accordance with the sound waves acting on the telephone transmitter. It is usually preferable, however, to use a large pliotron for producing the oscillations and to connect a small pliotron in the grid circuit of the large pliotron for controlling the output of the latter.

With the above arrangement an extremely simple and efficient radio-telephone outfit can be made. Since the pliotron for producing oscillations requires comparatively high direct-current voltages, it has been found convenient to combine the pliotron oscillator with a kenotron rectifier. Two types of apparatus of this type have been in use a considerable time.

In the first outfit, which is a small outfit having a capacity of about 20 watts in the antenna, the source of power is the local city supply, which is 118 volts, 60-cycle alternating current. This is connected with the primary of a small transformer, having two secondary windings. One of the secondaries is designed to give about 5 volts, and furnishes the current used for heating the filaments of the kenotrons and pliotrons. The other secondary of the transformer is wound to furnish a potential of about 800 volts. This is rectified by means of a kenotron, and serves to charge a condenser of about six microfarads. In this way a source of high-voltage, direct current is obtained in a very simple manner. The plate of the pliotron oscillator is then connected to one of the terminals of the condenser, while the filament is connected to the other. The plate of the second pliotron is connected to the grid of the first, while the grid of the second is coupled by means of a second small transformer to the microphone circuit. With this outfit, both pliotrons may be relatively small, and in order to obtain about 20 watts in the antenna, it is found that the current drawn from the condenser is so small that the potential supplied by it does not vary sufficiently to be audible in the signals sent out. The different parts of this apparatus may be made very compact, and no adjustments are found necessary in operating the system unless it is desired to change the wave length. In this case, it is only necessary to change the inductance or capacity.

In the second outfit, which is suitable for use up to 500 watts or more, the high-voltage direct current is obtained from a small 2,000-cycle generator. The current from this is transformed up to about 5,000 volts, rectified by kenotrons, and smoothed out by means of condensers. By the use of 2,000-cycle alternating current instead of 60-cycle, it is possible to store up large quantities of energy and thus obtain as much as a kilowatt or more of power in the form of direct current with condensers of moderate size. This high-voltage direct current is then used, as before, to operate a pliotron oscillator, the output of which is controlled by means of a small pliotron connected to the telephone transmitter.

By means of this system of control the amount of energy in the telephone transmitter circuit need be no larger than those commonly used in standard telephone circuits. It has thus been found possible to connect up this radio-telephone outfit with the regular telephone lines, so that conversation may be carried out between two people, both of whom are connected with the radio-stations by means of the regular land lines. It has also been found possible to communicate both ways over these lines.

NOTES FROM CANADA.

[FROM OUR SPECIAL CORRESPONDENT.]

SOME time ago it was pointed out in the REVIEW that the sign commonly used to denote cycles, viz., ~, is without a name, which, of course, is a very inconvenient state of affairs. To get over this difficulty, the writer would suggest the use of a ready-made Spanish word, "tilde," which is the name used for the sign, of almost exactly similar shape, used over one of the letters of the Spanish alphabet, thus, ñ; this name is not a hard one to remember, and its pronunciation—teeldeh—presents no difficulty whatever.

Whether the B.E.A.M.A. has perused these "Notes" during the last year or two is not known, but it would appear that action is likely to be taken before long on the lines indicated more than once herein, namely, the establishment of branches in the Colonies, especially in Canada, so that the local representatives of British firms may combine together for their common good and secure recognition, and effect reforms of certain existing conditions where individual efforts are bound to be ineffective.

The Dominion Government, through the Water Powers Branch of the Department of the Interior, has during the last few years been amassing information regarding water-power possibilities, which will prove very useful in the future, as the records of rainfall, run-off, stream levels, watershed areas, and storage possibilities, &c., extend over a sufficient length of time to give

reliable maximum, minimum, and average figures. The following are two brief extracts showing the kind of information which is published by the Department from time to time :—

1. "*Bridge River.*—A head of 2,000 ft. could be developed at Bridge River by driving a tunnel through the ridge separating it from Seton Lake. The water would be diverted into the tunnel from Bridge River and conveyed from the other portal by steel penstocks to the power-house situated on Seton Lake. A great amount of power could be developed here, but the cost of the tunnel would render a large initial development necessary."

2. "*Chehalis River.*—The plan of development of this stream includes a storage and intake dam near the lower end of Chehalis Lake and a large concrete pipe line, some 10 miles in length, to an equalising reservoir near the mouth of the river. The penstocks would lead from the reservoir to the power-house, and would give a head of about 400 ft. Chehalis Lake would give splendid storage."

An immense amount of information in the form of tables of stream flow data, &c., is embodied in these reports, as well as maps showing the location of the various water powers.

The Electrical Development Co., at Niagara Falls, on the Canadian side, is the first company to have installed plant up to the maximum capacity of its available water power. There are now four generators of 13,000 H.P. each, and seven of 15,000 H.P., making a total of 157,000 H.P.; of this amount, 125,000 H.P. represents the available water power, and the remainder is spare plant. All the power is to be used in Toronto.

Owing to the war, Toronto, which last year ordered large numbers of electricity meters from Germany, has this year arranged to buy British-made meters instead. *Sic transit gloria Germaniæ.*

LEGAL.

A Westinghouse Employé Fined.

At Manchester on Thursday, May 20th, the British Westinghouse Electrical and Manufacturing Co., Ltd., Trafford Park, claimed £5 from Thomas Henry Hargreaves, a surface grinder in their employ, for unlawfully absenting himself from work.

Sir Wm. Cobbett, for the company, stated that his clients had two surface-grinding machines, and defendant worked on one of them. The machines were used for putting a very fine finish on tools which were used for working upon shell fuses. The firm were under contract with the Government to supply munitions of war, and if one of the two surface grinders absented himself from his work it meant that 50 per cent. of the production of tools was stopped, the production of fuses for shells was impeded, and the company suffered substantial loss. The claim now brought was merely nominal; no attempt had been made to estimate the loss which had been sustained through defendant's action, but the magistrates would readily believe that it must have been substantial. Ordinarily the defendant worked 52½ hours per week, and was paid £2 4s., but he and the other surface-grinder sometimes worked as long as 80 hours per week, when their earnings were very much more than the figure mentioned. Unfortunately Hargreaves would not attend regularly to his work, and he was afraid the cause was drink. On several occasions he had absented himself, and had been warned, and the company had even taken him on when he was obviously not in a condition to do his best work.

Robert W. Wroe, foreman in the tool department, said the tools were absolutely necessary for the making of munitions of war, and surface grinding was highly skilled work. For some months past the company had been working at the highest pressure they had experienced since the works were opened. On one occasion when defendant returned to work after being absent he admitted that his absence had been due to drink, and he expressed his regret and said he would try to be teetotal. Later defendant was absent six days, with a consequent loss of 52½ hours. On April 12th they had to search for him, and when he was eventually found he returned to his work in a state of collapse after a drinking bout. The present summons referred to defendant's absence from May 3rd to May 8th inclusive.

The Bench ordered defendant to pay £4, and he was allowed a month to pay the money.

Glasgow Tramway Accident Claims.

Several cases arising from tramway accidents are pending in the Court of Session against the Glasgow Corporation. In one case a Dennistoun man sues for £500 damages for personal injuries. He was in the act of descending from one of the Corporation cars when, he says, the car was suddenly set in motion, and he was jerked off the platform. Fault is denied. In another case where a "violent jerk" is alleged as the cause of the injuries the Corporation pleads that the motorman brought the car to a standstill, preventing a collision. Yet another case in which a contractor sues for £500 is the sequel to a collision between a car and a lorry. The Corporation denies that the lorry was showing any lights, and says that the accident was due to pursuer's negligence.

Re W. T. Glover & Co., Ltd.

In the Chancery Division on Friday last week Mr. Justice Astbury sanctioned the proposed extension of the objects of W. T. Glover and Co., Ltd., of Trafford Park, manufacturers of electrical cables, wires and apparatus. Mr. Peterson, K.C., said the company was a prosperous one, and for the economical and convenient working of the existing objects as well as for the advantageous combination with other classes of business, it was proposed to acquire and work lead, copper and coal mines, and to smelt the ore and refine and treat the copper, lead and bitumen. The company also took power to sink wells, and with other companies to construct bridges across the Bridgewater Canal for the purpose of the extension of its works.

Traffic at Tramway Stopping Places.

Bailie Barrie, at Glasgow Southern Police Court, heard the first of the prosecutions under the new city by-law for the regulation of vehicular traffic near tramway stopping stations, which came into operation on May 1st, a taxi-cab driver being charged with having, at a point near a tramway stopping place, failed to draw up his cab before the roadway was clear of passengers entering or leaving a tramcar. In imposing a fine of one guinea, the magistrate said that the practice of driving in among passengers boarding or leaving tramcars must be stopped.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

B.T.H. Automobile Accessories.

Some interesting devices are described in a recent list (No. 10,780) of the British Thomson-Houston Co., Ltd., Mazda House, 77, Upper Thames Street, E.C., in connection with the use of electricity on automobiles. We illustrate in figs. 1 and 2 a

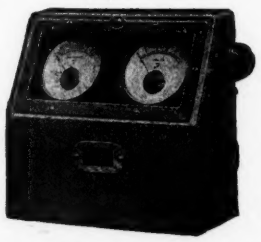


Fig. 1.—Switchboard Closed.

switchboard with a single handle, which performs all the necessary operations by actuating the controller shown in fig. 2. The various positions of the switch are indicated at a small window in the aluminium cover (fig. 1). The switch is so arranged that mishandling of the charging of the battery is impossible; whenever the head lights are put on, the charging switch is automatically closed; only the side and tail lamps can be used without charging, thus avoiding any overload on the battery. Ampere and voltmeters are provided, and a two-pin plug for connecting an inspection lamp. A tail lamp indicator in the shape of a small lamp giving a subdued light shows when the tail lamp is burning, and lights up the switch indicator and instruments sufficiently

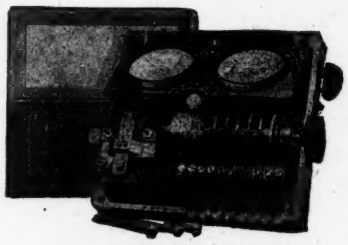


Fig. 2.—Switchboard Open.

to enable them to be read from the driver's seat; this lamp is not in series with the tail lamp, so that if anything goes wrong with it the tail lamp is not affected. The switchboard can be used with any standard dynamo, or with accumulators alone. A smaller set without instruments, but with a charging indicator and automatic cut-out, is also made.

Various other devices, such as car lighting and ignition batteries, meters, lamps, electric horns, sparking plugs, &c., as well as, of course, Mazda automobile lamps, are included in the list.

Spinning Extraordinary.

The name of the Benjamin Electric, Ltd., has always been associated with metal stampings and spinnings, their most well-known product in this direction being the Benjamin steel line of reflectors and reflector fittings, all of which are produced at their London works, 1A, Rosebery Avenue, E.C. A large amount of special work in the spinning line has been executed by the firm from time to time, and its latest effort on war material calls for particular attention, constituting as it does (as far as can be ascertained) a record for large spinnings. This consisted of a large quantity of aluminium covers and was executed for Government use. Fig. 3 gives a fairly adequate conception of the size of these spinnings, which were spun from aluminium blanks of

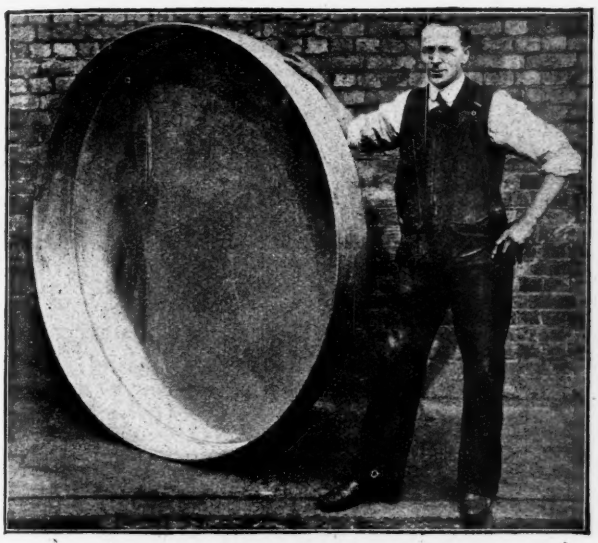


Fig. 3.—A Large Aluminium Spinning

14 G metal, 7 ft. in diameter, a proceeding demanding a maximum of care and precision, together with an expert knowledge of spinning as an art. The finished covers measured 5 ft. 6 in. in diameter, and were approximately 9 in. deep. Only a few works are equipped to carry out such spinning work as the above.

"Witton" Main Regulator.

The accompanying illustration shows a main regulator, which has been made by the General Electric Co., Ltd., of 67, Queen Victoria Street, London, E.C., for a large firm of turbo-alternator manufacturers. The "Witton" standard rectangular face-plate

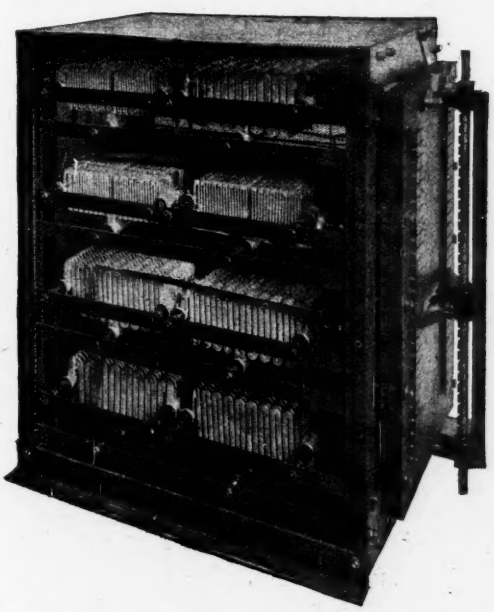


Fig. 4.—Interior of "Witton" Main Regulator, with Grid Resistances.

construction is used, together with standard grid resistances mounted on a strong angle-iron framework. The strength and compactness of the unit can be readily appreciated from the illustration.

WAR ITEMS.

Technical Institutions and Enemy Members.—The Iron and Steel Institute has struck the names of over 100 members of enemy nationality off its roll. Considerable numbers of enemy members are on the rolls of the Institutions of Civil and Electrical Engineers. It is reported that the German institutions are striking the names of members belonging to the Allied nations off their rolls, and German members of Allied institutions are renouncing their membership.

Writing editorially on this subject in its last issue, the *Engineer* says:—"The action taken by the Iron and Steel Institute at the annual meeting to close its ranks against enemy members raises a question of great interest at the present juncture. Under ordinary circumstances the war between Great Britain and other European nations need not have been waged within the confines of our technical institutions. It has always been one of the boasts of science that it did not recognise the boundaries created by geographers or politicians, and that even differences of race and language did not imply a divergence of interests when the claims of science were at issue. . . . . It is a thousand pities that this great tradition has been broken, but it can be honestly said that it is not the fault of Great Britain or her Allies. The truth is that the way in which Germany has chosen to wage war, culminating in the wholesale murders which accompanied the sinking of the *Lusitania*, has put her people outside the pale of civilisation, and even sane-minded engineers and clear-thinking scientists have realised that it is no longer possible to allow the nationalities now at war with us to claim even the kinship implied by membership of the same technical society. . . . . .

"It is clear that the action taken by the Iron and Steel Institute, although founded on a righteous indignation for the methods of our chief enemy, has not been dictated by either passion or prejudice, but is the outcome of a jealous regard for its own honour. There are other scientific and technical societies which, if they have not already done so, will no doubt take steps to erase from their list those foreign members who are to be numbered among our enemies. The Society of Chemical Industry, the Royal Institution, the Royal Society, the Institution of Electrical Engineers and others have a certain percentage of foreign membership. It may be that in some instances there are technical difficulties and legal objections to be overcome. These, however, should not be allowed to stand in the way, and we may expect to hear that all our engineering and scientific bodies have eliminated from their roll of membership all subjects of the countries with which Great Britain is now at war, if for no other reason as a protest against the inhuman methods of warfare introduced by our enemies. This is not the time to shrink from the performance of a plain duty."

Lamps for Johannesburg.—We have received a cutting from the *Cape Times*, in which its Johannesburg correspondent states, under date April 28th:—"At the Johannesburg Town Council last night, the Finance Committee recommended the acceptance of Messrs. H. Davies & Co.'s tenders for the supply of electric lamps, at a cost of £1,142.

"Mr. Williamson pointed out that presumably the articles that were proposed to be accepted were made in Holland. The difference between these and the tender for British-made lamps was £500 against the latter, and they might reasonably assume that these lamps made in Holland were really made in Germany. In fact, he had evidence to that effect. They did not know what the position of Holland was in regard to the war, but in view of the latest information it might be that Germany had got Holland to come into line with her. It was, therefore, the duty of Britishers, no matter what the cost, to keep the British workman in employment. Was their money to be given to British workmen, or was it to go to Holland for the real benefit of Germany? Indeed, this tender of Davies & Co. could not be so low if it were not a real case of dumping. They had every ground to have suspicions of the low price—30 to 40 per cent. below the British price. He had nothing to say against Holland, but the sentiment of the Council should at once and always be in favour of Great Britain. He opposed the recommendation. Holland was merely a receiving house for Germany, and the money they sent to Holland would in this case be wages for German workers, either in whole or in part, for lamps such as these.

"Mr. O'Hara moved that the report be referred back, and supported the principal arguments advanced by Mr. Williamson. Mr. Murray seconded. Mr. Deys objected to slurs upon the attitude of a neutral country—Holland.

"The amendment was finally negatived, and the report adopted."

No Municipal Money for Pipes Band.—At last meeting of the Glasgow C.C., Councillor Taylor drew attention to a proposal by the Electricity Committee to present to the Division of Royal Engineers and Brigade of Artillery, which are being raised by the T.C., the necessary equipment and instruments for a pipe band. He contended that the Committee had no power under its Act to take any part of its revenue for this purpose, and he held that the expenditure was therefore illegal. The Town Clerk concurred in this view, and the Lord Provost declared the minute incompetent.

Oldham Tramways and War Bonuses.—The refusal of the T.C. to grant a war bonus to certain section of the employés has caused much dissatisfaction to the men concerned, and a demand is being made to have the question reopened. The T.C. has twice refused the application on the plea that it would mean an extra burden on the ratepayers.

E

Electric Sterilising of Wounds.—Amongst the hospital applications of electricity in the European war is reported the sterilising of wounds by zinc. A pad with zinc sulphide is placed on the wound, and being connected to the positive pole of a battery, is said to make the surrounding tissues antiseptic by the zinc salt forced into them. The method is pronounced efficient and speedy wherever available.

Board of Trade Inquiries.—In the list issued by the Board of Trade C.I. Branch for the week ended May 15th, the following inquiries for sources of supply of goods are recorded:—

Electrical apparatus, &c.:—
- Brass sockets with vitrite case for electric metal-filament and carbon lamps.
- Cables, porcelain insulators, and electric lampholders.
- Electric lamps (wire drawn, economical).
- Electric pocket lamps.
- Wooden mounts for electric light fittings.

Glass and glassware:—
- Miners' lamp-glasses.
- Opal shades for electric lights.
- Tubing (sample).

Names of firms abroad open to purchase the following articles have also been received and recorded:—
- Agate bearings for scales and electrical meters.
- Diesel engines.
- Electrical accessories, unspecified.

Glass and glassware:—
- Chemical beakers and test tubes.

Westinghouse Staff and Munitions of War.—We learn that a movement was started a short time ago by the engineering and other office staff of the British Westinghouse Electric and Manufacturing Co., Ltd., to express in a practical form their patriotic feelings, and it was suggested by them to the management of the company that they should undertake in their spare time some manual work on munitions of war. This offer was accepted by the management, and operations were commenced almost immediately. For the present, each man will work a 5½ hours' shift one night per week, commencing at either 6.30 in the evening or 12 o'clock at night. We understand that approximately 300 staff men have already volunteered for work on this basis.

Technical Schools and Munitions.—The Industrial Reserve, of 227, Strand, W.C., is organising the technical schools throughout the country in connection with the production of munitions of war; the results already attained are very satisfactory. It is proposed to employ members of the Reserve in small engineering shops, supplying larger firms with standardised small parts.

Personal.—On the occasion of his departure to take up a lieutenancy in the Royal Marines (Submarine Miners), Mr. H. M. Taylor, borough electrical engineer of Middlesbrough, was presented by the staff of his department with a wristlet watch. Councillor Joseph Calvert, J.P. (chairman of the Electricity Committee) made the presentation. He stated that he could pay no greater compliment to Mr. Taylor than mention the fact that the majority of the staff had been with him during the whole of his 13 years' service, working harmoniously the whole time. He felt sure that Mr. Taylor's knowledge would be of great service to the Royal Marines. Mr. Taylor suitably responded. A few remarks by Mr. Telford and Mr. Scotson brought the ceremony to a close.

Mr. Thos. Edwin Scharffetter, of Hale and Manchester, electrical engineer, a natural-born British subject, has adopted the surname of Shorter.

Owing to unfounded rumours as to the nationality of Mr. C. A. Blascheck, city electrical engineer at Canterbury, the Mayor, on May 19th, deemed it necessary publicly to state that Mr. Blascheck was not a German, but an Englishman. His father was a German, who came to England 48 years ago, and three years later was naturalised. Mr. Blascheck's mother was an Englishwoman, and Mr. Blascheck was born in England, and had lived in the country all his life, except for a few years, during which he was sent to Germany to learn the technical work of his profession. The Council passed a vote of confidence in Mr. Blascheck.

Private T. Flynn who, before the war, was engaged at Darwen electricity works, states in a letter home:—"If there is a single man in England to-day physically fit for the Army or Navy and he has not joined he must be wholly ashamed of himself."

Roll of Honour.—Mr. Leslie Smith, of Blackburn, has been wounded in the Dardanelles. Four years ago he left Blackburn, where we was employed as an electrician, for Australia, and on the outbreak of war joined the Infantry Brigade. He sailed on the ss. *Duflinger*, a captured German ship, and Private Smith was made the ship's electrician. He had only been in the firing line an hour when hurt.

Private Chas. Walker, of the clerical staff of the Torquay Corporation electricity works, has been killed in action. On the outbreak of war he joined the 2nd Devon Regiment. Private Fred. Squires, of the same regiment, who was a conductor on the Paignton section of the Torquay tramways, has also been killed at the front.

Intelligence has been received at Chelmsford that Lieut.-Com. Hubert Dobell, Royal Naval Volunteer Reserve, is missing, and that it is believed that he was taken prisoner whilst making observations for aircraft. Prior to the war he was on the Marconi Experimental Staff, at Chelmsford.

Private John Chumley, who had been employed in the power house at the works of the St. Helens Cable Co., has been killed in action. He was 24 years of age. His father, Mr. Samuel Chumley, is also employed by the St. Helens Co.

We deeply regret to read in the *Times* advertisements that Lieut. Brian Crossley, 3rd Batn. Highland Light Infantry, attached 2nd Batn., youngest son of the late Sir Wm. Crossley, Bt., was killed in action in France on May 18th. Lieut. Crossley was known to many of our engineering readers by reason of the part he filled in the famous firm of Crossley Bros., Ltd., of Manchester. He was 29 years of age.

BUSINESS NOTES.

Catalogues and Lists.—RICHMOND GAS STOVE AND METER CO., LTD., Warrington.—Illustrated list, giving brief descriptive notes relating to natural draught gas-heated furnaces, &c., for expediting the production of shells and war requirements. The furnaces are in service in the principal ordnance factories and by motor and engineering firms.

MESSRS. TURNER BROS., LTD., Rochdale.—Folders drawing attention to their hair and Balata belting.

MESSRS. J. H. HEATHMAN & CO., Parson's Green, Fulham, S.W.—Card giving prices and particulars of their patent fold-up step ladder with chair seat.

MESSRS. SIMPLEX CONDUITS, LTD., 116, Charing Cross Road, London, W.C.—A series of eight serviceable size blotters has been issued, the letterpress side of which keeps before the mind of the user one or other of the company's specialities—conduits, distribution boards, watertight accessories, electric light fittings, hand lamps, and shop window reflectors. Also a small eight-page booklet entitled: "Wiring for Electric Light and Power," and dealing generally with the merits of the Simplex conduit system. Copies of either the blotters or the booklet will be sent to any engineer on application.

MESSRS MICKELWRIGHT, LTD., Alperton, Wembley.—Illustrated priced leaflets relating to their sliding contact resistances.

WORTHINGTON PUMP CO., LTD, India House, Kingsway, London, W.C.—Twelve-page illustrated pamphlet (No. 1,054) containing a description of a new type of motor-driven rotary dry-air pump, which they are putting on the market.

Book Notices.—We have received a copy of No. 2 of the "Records of Railway Interests in the War," published by the *Railway News* (one shilling). It is fully and interestingly illustrated, and contains a vast quantity of information concerning the many ways in which British railways and their staffs and employés are performing their part in connection with the war.

"Continuous Current Electrical Engineering." By W. Tolmé Maccall. London: University Tutorial Press, Ltd. Price 10s. 6d.

The May issue of *The Central* contains articles on the British Association visit to Australia, by G. W. O. Howe; the mercury arc, by T. M. Lowry; Diesel engine troubles, by A. C. Branch; the possibilities of domestic electricity, by H. W. Purle; and various other matters, as well as a Roll of Honour containing no fewer than 633 names—341 officers and 292 of other ranks. From the Imperial College as a whole the total number of men on active service is about 1,030. The annual report of the Old Centralians for 1914 shows a very satisfactory condition as regards both proceedings and finance.

Messrs. A. P. Lundberg & Sons have issued a third edition of their booklet, "The Teaching of Electric Light Switching," a subject which has now obtained a firm footing in technical colleges. Teachers of wiring classes will find this an excellent guide in arranging their lecture and demonstration courses.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXIV, No. 5. May, 1915. New York: The Institute. Price $1.

For Sale.—Kirkcaldy Corporation has for disposal 3,600 pairs of Conradty "C" carbons, particulars of which are given in our advertisement pages to-day.

South Africa.—A firm of agents in Cape Town, with a branch office in Johannesburg, a partner of which will shortly be in London, desires to secure the representation of United Kingdom manufacturers of high-class electrical and art metal fittings. Apply to the Board of Trade, C.I. Branch, London, for particulars.

Deed of Assignment.—LOUISA FELLOWS (L. Fellows), electric light contractor, 72, Victoria Road, Surbiton.—Last day for claims for dividend, June 2nd. Trustee, Mr. G. C. Corfield, Balfour House, Finsbury Pavement, E.C.

Liquidations.—OLDHAM BOILER WORKS CO., LTD.—Particulars of claims must be sent by July 3rd to the liquidator, Mr. H. Hague, Retiro Chambers, Yorkshire Street, Oldham.

ATLAS ELECTRICAL CO., LTD.—This company is winding up voluntarily, with Mr. P. F. Hedges, of 53, Cannon Street, E.C., as liquidator. A meeting of creditors is called for June 1st.

Trade Announcements.—The building occupied by MESSRS. TYLER & FREEMAN, at 20, New Bridge Street, London, E.C., for the last 19 years is being pulled down and the firm are moving to larger premises at 40, Chancery Lane, W.C. New telephone Nos.: Holborn, 6490 and 6491. Telegraphic address: "Potential Holb., London." Firms are invited to forward copies of recent catalogues.

The GATH ELECTRICAL ENGINEERING CO., with which is incorporated E. Sykes, is, after reconstruction, opening showrooms in Southgate, Halifax.

Fire.—On May 21st, a fire occurred at the premises of MESSRS CHARLES MACINTOSH & CO., LTD., india-rubber manufacturers, Chorlton-on-Medlock. The fire broke out in the spreading department, which was practically destroyed.

Bankruptcy Proceedings.—H. J. GODFREY, electrical engineer, late of 188, Balham High Road, S.W.—A first and final dividend of 9½d. in the £ is payable on June 11th, at the Official Receiver's offices, 132, York Road, Westminster Bridge Road, S.E.

LIGHTING and POWER NOTES.

Accrington.—PRICE INCREASE.—It is stated there is to be an advance of 20 per cent. in the Corporation's charges for current to electricity users, and, in addition, the discount of 10 per cent. hitherto allowed may be reduced to 5 per cent., so that, if these proposals are carried through, the advance will be equal to about 27 per cent. on present charges.

Aldershot.—PLANT EXTENSIONS.—The L.G.B. has asked the Council to furnish a detailed statement of the works considered necessary on account of war requirements, and for which a loan of £8 500 has been applied for. The engineer and the chairman of the Lighting Committee are to wait on the L.G.B. with reference to the matter. As it is deemed imperative that the new boiler plant should be at once installed, it was decided to take the money needed temporarily from reserve, and refund it if a loan is sanctioned.

Argentina.—By decree of the National Government, the clause in the new port of Buenos Aires construction contract providing for the erection of an electric power house and machinery by Messrs. C. H. Walker & Co., has been annulled.

Aylesbury.—The U.D.C. has approached the Bucks Education Committee as to proposals for electric lighting, and the Committee has replied that at present it cannot entertain the question.

Barnsley. — ELECTRIC COOKING. — The Borough Education Committee has decided to install an electric cooker in the kitchen for the new open air school.

Bitterne.—PROV. ORDER.—The B. of T. has informed the South Stoneham R.D.C. than an order has been granted to the Southampton T.C. to extend the E.L. mains to Bitterne, but that the order will not come into operation until after the war.

Blackpool.—The electricity returns continue to show a big increase in private lighting; the output during April was 16,770 units more than during the same month last year. Public lighting took 7,420 fewer units, and the Corporation tramways demand was 20,390 units down.

Bury (Lancs.).—PRICE INCREASE.—The Corporation Electricity Committee has decided to increase the price of electricity from July 1st. The charges for private lighting, public lighting and tramways will be increased by the addition of 10 per cent. to each account, and that for power and heating by the addition of 15 per cent.

Castletown-Berehaven.—L.G.B. INQUIRY.—An inquiry is about to be held into the powers required for the lighting of the town; the introduction of an electrical system has been suggested.

Continental.—SPAIN.—A concession has lately been granted for the establishment of a plant to utilise the water power of the river Mundo at Hellin for the generation of electrical energy for lighting and power purposes.

Crayford.—The West Kent Electric Co., which has secured the lighting of 200 houses to be erected on the Northumberland Heath Estate, has asked the P.C. to allow it to quote terms for the street lighting of the estate. The matter has been referred to the Lighting Committee, which is considering the lighting of the Barnes Cray Estate.

Cumberland.—POWER SCHEME.—The *Manchester Dispatch* states that great importance attaches to a scheme in progress, under the auspices of the Cumberland Waste Heat Owners' Co., Ltd., in which the Whitehaven Hematite Iron and Steel Co., Ltd., is largely interested, for the conversion of the waste gases from the furnaces at Cleator Moor into electrical power for the ore mines in the north-west hematite producing district. The plant, which will have a capacity of 2,200 KW., will be in operation by the end of June.

Darlington.—The L.G.B. has informed the T.C. that loans will not be advanced for the laying of mains and connections. The Electricity Committee is considering the desirability of increasing the charges for current.

Ely.—PROV. ORDER.—The Gas and Electricity Co. has decided not to proceed with the application for a prov. order for E.L. in the Urban Council's area. Objections had been lodged with the B. of T. by the Ratepayers' Association and others.

Grays.—LOAN REFUSED.—The L.G.B. has informed the U.D.C. that at the present time it cannot sanction the loan of £600 applied for, for electricity purposes.

Hants.—ASYLUM INSTALLATION.—The C.C. has decided to adopt electricity at the new Asylum at Park Prewett for pumping, laundry and baking machinery, cold storage and auxiliary cooking plant. The voltage will be 220 for the installation; on the grounds of cleanliness and convenience it has been decided to install the light in the cottages.

Harrogate.—EXTENDED SUPPLY AREA.—The B. of T. has granted the T.C. an order authorising it to supply current at Nidd, Plompton, Starbeck, Pannal, Haverah Park, Hamp-thwaite, Killinghall, Ripley, Birstwith, Hartwith-cum-Winsley, and Clint.

Huddersfield.—RESTRICTED LIGHTING.—On account of the non-lighting of arc lamps, the Corporation Electricity Committee has allowed the T.C. a rebate of 50 per cent. off the public lighting account.

Kettering.—YEAR'S WORKING.—During the last financial year the Council's electricity undertaking sold 1,890,544 units, the maximum demand being 1 102 KW. The total revenue amounted to £15,107, and working expenditure to £7.448, leaving £7.659 as gross profit. Financial charges absorbed £3.953; £1,000 was placed to reserve fund, which now totals £3,200; and a balance of £4.387 was carried forward, as against a balance of £3,663 brought forward from the previous year.

Kingston-on-Thames.—The Sanitary and Drainage Committee has agreed to an increased charge of 10 per cent. for all current used for sewage works purposes.

Leek.—INCREASED PRICES.—The U.D.C. has decided to advance from July 1st the present charges for current to all consumers by 10 per cent.

London.—HAMMERSMITH.—The Electricity Committee has decided to give supplies of electricity to the Notting Hill Electric Lighting Co., Ltd., and Fermans, Ltd., at a uniform rate of 1½d. per unit, less 33⅓ per cent. discount when the supply for power and lighting exceeds £100 per annum.

STEPNEY.—The L.C.C. has informed the B.C. that the borrowing of £15,000 for mains may be sanctioned, but that the order sanctioning the borrowing will not be issued until the B.C. has agreed to limit expenditure on the provision of mains during the war to the laying of mains to supply electrical energy to consumers engaged on work for the War Office or Admiralty only. The Electricity Committee recommends the Council to agree to this.

The Electricity Committee reports that the plant necessary to enable the Council to furnish the Shoreditch Council with electrical energy in bulk has been installed and will be available on September 30th next. It is necessary under the terms of the supplemental agreement to give the Shoreditch B.C. notice by June 30th of the Council's ability to give this supply. The borough electrical engineer has been authorised to give such notice.

Manchester.—L.G.B. INQUIRY.—On the 21st inst. an inquiry was held into an application of the Corporation for sanction to borrow £543,000 for the provision of a new generating station at Barton. It was explained that the increased demands were entirely due to engineering and other firms in the city for the manufacture of war munitions, and, with one exception, Manchester was supplying more current than any other undertaking for the manufacture of munitions of war. Mr. S. L. Pearce, the chief electrical engineer to the Corporation, said if the application were not granted, the undertaking would have to refuse any further increase in supplies of current. The application now was for sanction to borrow £432,000. The Corporation would postpone the carrying out of the work involving the balance of the amount. The inspector announced that his instructions were to deal with the Manchester Corporation's application at the earliest possible moment.

Middleton (Lancs.).—The annual accounts state that public lighting will next year require £2,326, a reduction of £200 on the year previous, and foreshadow the postponement of the proposed extension of electric lamps.

Oldham.—YEAR'S WORKING.—The profit of the electricity department for the past year, subject to audit, is £3,550 (or £1.555 more than in the previous year), and this, added to the reserve fund, brought that to £12,979. The reserve will have to be spent on extensions which are now being made, in consequence of the bar on new loans. Units sold during the year amounted to 7,985,000, an increase of 929 000 units, and a record. The cost of production was ·606d. per unit, compared with ·684d. last year.

Peterborough.—The T.C. has given Messrs. Aublet, Harry & Co., of Westwood, permission to lay an electric cable to their works from those of Messrs. Werner, Pfleiderer and Perkins, on condition that when the municipal mains are extended to the district the supply of current will be taken from the Council.

Plymouth.—YEAR'S WORKING.—The annual report of the electricity department on the Newport Street electricity undertaking of the Corporation to March 31st, shows a sale of 2,520,420 units, producing estimated receipts of £21,790, compared with 2,277,223 units sold, and £19,981 received in the previous year, an increase of 243,197 units in the consumption of current, and £1,808 in the receipts.

Rawtenstall. — STREET LIGHTING. — The T.C. has decided to light Booth Road, Waterfoot, by electricity, and the work is to be proceeded with at once.

Salford.—YEAR'S WORKING.—For the past financial year the total revenue of the electricity department amounted to £117,584 as against £111,412 in 1913-14. The total working costs, inclusive of £6,414 for energy purchased, amounted to £65 776; this comparing with £67,232 in the previous year when £3,152 was paid for purchased energy. The generating costs at Salford fell from '82d. to '76d. per unit in 1914-15. The gross profit for the two years 1914-15 and 1913-14, was £51,808 and £44,180, and net profit, £8,406 and £3.629 respectively. Some 20 646 000 units were sold, being about a million in excess of the previous year.

Southend-on-Sea.—The T.C. has granted a supply of current at 1½d. per unit to a consumer for power purposes in connection with a medical apparatus used for three hours daily for the treatment of tuberculosis of the skin. The current is to be used only between 6 a.m. and 6 p.m.

Southport.—The Council has approved a recommendation of the Finance Committee to increase the rates by 3d. in the £, and to increase the gas and electricity charges by 10 per cent.

South Shields.—A formal inspection of the extensions recently carried out at the electricity works (and described and illustrated on page 693 of the ELECTRICAL REVIEW) was made on the 19th inst., at the invitation of the chairman of the Electricity Committee. It was pointed out that two turbine plants of 3,500-KW. normal capacity had been put down in the space occupied by three reciprocating sets totalling 400-KW. capacity.

South Wales.—WAGES CONFERENCE.—As the outcome of a conference between electrical contractors at Cardiff and Barry and the Electrical Trade Union, the following agreement has been arrived at:—Wages for electricians, cable jointers, and electrical fitters to be 9½d. per hour, with an increase to 10½d. in November; wages of armature winders to be 10d., with an increase to 11d. in November.

Stafford. — YEAR'S WORKING. — The report of the electricity department for the past year shows an increase of 250,000 units sold, bringing the total for the year to over a million. The revenue from all sources amounted to £7,194, an increase of £814, while the total expenditure was £3,562, as against £3,934 in the previous year. The Committee recommends that £1,000 be transferred to the depreciation fund, and £100 as a contribution to the gas department, leaving a gross profit of £2,444, an increase of £87 on 1914. In pursuance of the arrangement as to profit sharing, the Committee recommends the payment of a bonus on the wages of the officials and workmen of the electricity department, of 14·6 per cent., as compared with 12·0, 10·0 and 11·7 per cent. in the three preceding years; it was decided that the maximum bonus in the electricity department should be 15 per cent.—*Staffordshire Advertiser.*

Wakefield.—STANLEY PROV. ORDER.—The Corporation is petitioning Parliament against the Stanley (Yorkshire) Electric Lighting Prov. Order, asking to be heard when the confirming Bill comes before the Committee. The Wakefield Corporation's locus is objected to by the promoters of the order, and the Court of Referees is to decide the point on June 9th.

Watford.—The B. of G. has decided to install an electric motor for driving the water pump at the Workhouse.

Willesden.—The L.G.B. has sanctioned the borrowing by the U.D.C. of £1,112 for the purpose of laying a feeder cable from Acton Lane sub-station to Craven Park. It is proposed to substitute a feeder pillar for the disconnecting boxes now in use on the cables at Craven Park; also to interview the L.G.B. with a view to obtaining authority to raise part of the loans, amounting to £20,000, for prospective mains and services, sanctioned by the Board in August last year. The Committee is to hold a special meeting for the purpose of considering the report presented by the electrical engineer on new terms for electrical bulk supply and an estimate for a new generating station, &c.

Ystradgynlas.—PROV. ORDER.—The report dealing with the Council's negotiations for the taking over of the plant of the Glantawe Electric Supply Co., Ltd., states that the provisional order had been granted, but the B. of T. had included one or two additional clauses, which provided that the order should not come into operation until the termination of the war and at the time must be taken up within 15 months, the works to be transferred within the subsequent three years.

TRAMWAY and RAILWAY NOTES.

Accrington.—The Committee has empowered the tramway manager to engage women conductors if the necessity arises, as many of the conductors have joined the Colours. Women conductors will be paid at the same rate as the men.

Ashton-under-Lyne.—The tramway authorities have refused to concede an all round increase of 1d. per hour to tramway employés.

The tramwaymen held a mass meeting on Sunday, at which it was decided to invite the authorities to submit the application to arbitration.

Bolton.—STRIKE.—On Saturday last the whole of the employés of the Corporation tramways came out on strike. A certain number of cars, about 30, were run on the first journey, after which not a single car was run during the day. The service was also stopped on Sunday and Monday, and neither the Bury Corporation nor the South Lancashire Co., who run into Bolton, took cars within the borough boundaries.

The Tramways Committee passed a resolution instructing the general manager to arrange for certain services, and that in the event of any motormen or conductors refusing to carry out the orders to enable such cars to be run, their services in the tramways department be dispensed with. Motormen for extra time involved would receive about 3s. 8d. and the conductors 2s. 11d. to 3s. 4½d.; the men do not like the idea of working at night after starting about 4.30 in the morning. Since the outbreak of war 102 tramway employés have enlisted, while 51 left their employ to work in foundries, &c., making a total of 153 out of 450. The Tramways Committee has decided to make no payments to dependents of its employés who have not already enlisted. The Committee is at present paying £35 per week to dependents of employés who are with the Colours.

Burnley.—FEMALE LABOUR.—A proposal to employ women as car conductors has been left in the hands of the chairman of the Tramways Committee and the tramway manager for investigation.

Continental.—SPAIN.—The Sociedad Hispano-Belge de Ferrocarriles, Mineria y Industria, is reported to be preparing plans in respect of a projected narrow-gauge electric railway between Fonsagrada and the Port of Ribadeo.

Darlington.—FEMALE LABOUR.—The T.C. has arranged for eight female conductors to be employed, owing to the tramway staff having been depleted by enlistments. They will work eight hours daily, and receive between 19s. and 20s. per week.

Glasgow.—FEMALE LABOUR.—There are now 150 fully trained women acting as conductors of Glasgow tramway cars, and on Tuesday another 50 women started training under the direction of male conductors, so that by Saturday 200 females will be engaged at the duties.

The Tramway Committee has, by a majority, recommended that all soldiers and sailors while in uniform be allowed to travel on the cars at half fare, the minimum half fare to be ½d.

Halifax.—TRAMWAY ACCIDENT. — A serious tramway accident occurred on Saturday night to a car travelling from Ovenden to Halifax, which left the track, turned round and toppled over on to its side. Between 20 and 30 passengers were so injured that they had to be removed to the Halifax Infirmary. The accident occurred at a sharp turn in the roadway where there is a steep gradient. The car was considerably damaged. The cause of the accident is not known.

Huddersfield.—YEAR'S WORKING.—The result of the past year's working of the tramway undertaking shows a surplus of £10,208, as compared with £8,800 in the previous year, after allowing £13,707 for depreciation. Out of this surplus £8,400 is to be put to relief of rates.

India.—The Karachi Electric Tramway Co. has received a franchise to extend its tramway lines. The new line has been needed for some time and promises to be profitable. Actual construction probably will be delayed a short time, but owing to the war, labour is now cheap, and work probably will be undertaken at no distant date.—*Far Eastern Review.*

Japan.—At a recent meeting of the Tokyo City Electric Enterprise Investigation Committee one of the municipal officials stated that the receipts from the enterprises were not sufficient to meet the repayment of the municipal loans. The municipal authorities propose raising tram fares in the immediate future by at least 1 sen per ticket, and this has caused indignation among some sections of the citizens, who are backed up by prominent members of the City Assembly.—*Far Eastern Review.*

London.—L.C.C.—Although the strike on the Council's tramways still continues, there are signs that a settlement will not long be delayed. During the week the Council issued a demand that all drivers and conductors of military age should return their uniforms, and the inspectors of all depôts have been instructed that no man is to be taken on again if he is eligible for military service. The department has had many applications from suitable candidates above military age for the vacant positions, and, in addition to the old training depôt, four new training schools have been opened at which the new men are receiving the necessary training as drivers. Efforts are being made by the men's unions to bring about a settlement through the B. of T.

One of the Union officials has stated that it is highly probable that within a week or so some form of National service may be decided on and that the Council has taken the opportunity of getting rid of men who would in any case probably have to go shortly.

The Woolwich Arsenal tramway service is now in satisfactory operation, and the general services are being improved daily.

Manchester.—Year's Working.—The annual report of the tramway undertaking states that the total revenue was £901.875, a decrease of £23,434 on the previous year. The balance, with bank interest, and after deducting working expenses and war allowances, amounted to £312,285, out of which £100,000 had been given to aid the rates. The aggregate length of single track open, including lines over which the Corporation had running powers, was 195 miles; parcels carried numbered 1,236,500; and the total number of passengers was 202,768,420. Weekly allowances to employés who have enlisted amounted to £1,316 and the collections on the cars for war funds have realised £11,286.

Preston.—Female Labour.—The Tramways Committee's application for female conductors has brought an extraordinary response. It is intended in the first instance to put 14 or 15 women on the Ashton-on-Ribble section for probationary purposes, but it is probable that in due course the conductors on all cars will be women. As learners they will be paid half rates, but as qualified conductors they will start at the minimum rate for men, viz., 5d. per hour.

Salford.—War Bonus.—The tramway men have decided to accept the Corporation's offer of a war bonus similar to that recently awarded by arbitrators at Newcastle. Regarding the employment of women on the cars, the men have decided to ask the Corporation to withdraw female labour, and they will endeavour to find a suitable supply of male labour for the cars. Should this endeavour be unsuccessful the men have decided upon the conditions on which they will be prepared to work with women.

South Africa.—Electric Vehicles.—The South African General Electric Co., which is pushing the sale of electric vehicles in South Africa, has lately established a charging station and garage in Cape Town, where customers' cars can be charged and garaged.

South Staffordshire.—The Black Country tramwaymen have decided, by 72 votes to 62, to accept the bonus of 2s. a week offered by the companies. The men's demand was for an increase of ½d. per hour.

Whitworth.—The U.D.C. has decided that the Tramways and Electricity Committee be dispensed with for the present year, and that the work (if any) be done by the whole of the Council.

TELEGRAPH and TELEPHONE NOTES.

Jamaica.—To supply a need felt by the British Navy, a powerful wireless station is being built on the highlands of the Island of Jamaica, 3,000 ft. above the level of the sea.

A force of about 300 men has been working on the plant for two months. The new station is being constructed by the British Government, and no details as to its equipment or range have been permitted to become public, except that the plant will be a very powerful one with a long radius of action.

Nottingham.—As the result of experiments which they have been conducting, Messrs. Farse & Co, electrical engineers, have received a large Government contract for the supply of telephone mechanism, which, it is said, will ultimately amount to over £250,000. Hitherto these telephone parts have been a German monopoly, so that the contract may mean the establishment of a new industry in Nottingham.

Time Signals.—It is stated that arrangements are in working order for the daily transmission of a wireless time signal for the use of shipping in South African waters, through the medium of the Union Government wireless station at Slangkop.

Wireless Signalling on Railways.—Experiments are being conducted this week on a section of the London and South-Western Railway Co.'s system with five engines equipped with wireless signalling apparatus.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Melbourne.—June 15th. City Council. Four mechanically-fired boilers, one turbine-driven boiler-feed pump, two fuel economisers, circulating water pumps. City Electrical Engineer. Specifications from Messrs. McIlwraith, McEacharn & Co., Ltd., London, E.C.

June 30th. Victorian Railway Commissioners. One 13-in. centre lathe for turning or grinding commutators for traction armatures; one 9-kw. motor-generator and battery-charging accessories; four electric motors.*

July 14th. Victorian Railway Commissioners. Supply of 60,000 flame arc carbons for use in Ganz flame arc lamps (Contract 28,811); aluminium feeder, insulators, feeder taps, and terminal anchoring and joint clamps, for St. Kilda-Brighton electric street railway (Contract 28,817).—*Australian Mining Standard.*

Sydney.—July 12th. Metropolitan Board of Water Supply and Sewerage. Two steam turbines and condensers at Ryde pumping station, for the Chatswood pumping plant. Secretary, 341, Pitt Street, Sydney.

July 19th. Council. Maximum-demand indicators. Specification (10s. 6d.) from Electric Light Department.

July 19th. Municipal Council. One or two 12,000-kw. turbo-alternators (Contract No. 363).* A copy of the specification can be obtained from the City Electrical Engineer, Sydney.

July 19th. Steel towers for 33 000-volt transmission line. Specification (10s 6d.) at E.L. Department, Town Hall.

July 21st. N.S.W. Government Railways and Tramways Department. One 250-k.v.a. turbo-generator.*

Adelaide.—June 30th.*—Deputy P.M.G. 120 miles of outside distributing wire; 123 miles of insulated copper wire

July 7th.*—27,000 jointing sleeves and 55 000 copper binders.

Perth.—July 7th. Deputy P.M.G. 31,000 porcelain or alternatively stoneware insulators (Schedule 432 W.A.).*

Specifications for the items marked * can be seen at the B. of T. Commercial Intelligence Branch in London.

Dublin.—June 7th. Electric passenger lift for Irish United Assurance Society. See "Official Notices" to-day.

Dundee.—June 4th. Corporation Electricity Department. Reinforced-concrete floors and jointless flooring, required for the extension to Carolina Port generating station.

Eccles.—June 9th. Corporation. Installation of the electric light at the Anson Street Council Schools, Winton. Forms of tender (10s.) from Mr. E. Parkes, Town Clerk, Town Hall.

Edinburgh.—June 21st. Two 5,000-kw. turbo-alternators and condensing plant, for Portobello supply station. See "Official Notices" May 21st.

Edmonton.—June 1st. Maintenance of the intercommunication fire alarms at the various elementary schools in Edmonton for 12 months for the Education Committee. Architect, Town Hall, Lower Edmonton.

Finchley.—May 31st. U.D.C. Wiring, for light, 100 workmen's dwellings. See "Official Notices" May 7th.

Kirkcaldy.—June 14th. Corporation. 100 half-watt 1,000-c.p. lamps and lanterns for street lighting. See "Official Notices" to-day.

London.—L.C.C.—June 4th. Installation, 260 wiring points, 345 lights, also electric bells, at the County Secondary School, South Hackney. See "Official Notices" May 21st.

St. Pancras.—June 14th. Corporation. Twelve months' supply of Welsh and steam coal for the electricity stations and baths.

West Ham.—June 14th. Installation of lighting and water-heating apparatus at Knox Road Special School, for Education Committee. See "Official Notices" to-day.

Manchester.—June 2nd. Corporation. Coal-unloading crane, conveying plants, &c. See "Official Notices" May 7th.

New Zealand.—Christchurch.—July 3rd. House service meters for the City Council. Specifications from the City Electrical Engineer's office.—*New Zealand Shipping and Commerce.*

Portsmouth.—June 1st. Corporation. 100 tons of steel girder tram rails, five tons of steel fishplates, one ton of fishplates, three tons of 5-ft. wrought-iron tie-bars. See "Official Notices" May 14th.

Rangoon.—August 11th. Installation of a system of fire-alarms, for the municipality. Specification (10s.) from Messrs. Ogilvy, Gillanders & Co., 67, Cornhill, E.C.

Redditch.—June 14th. H.T. three-phase switchboard. See "Official Notices" to-day.

Rhondda.—June 4th. U.D.C. Water-storage tank (30,000 gallons), for Porth Electricity Works. See "Official Notices" to-day.

Tasmania.—Launceston.—July 26th. Sub-station equipment. Section I, Converter machine, switchgear, &c.; Section II, Underground feeder cable. Specification (21s.) from the City Electrical Engineer, Town Hall.

Hobart.—July 5th. Lead-covered telephone cables; glassware and other material for batteries; telephone instruments and parts,

including switchboards; iron work; various insulators; iron, steel, copper and bronze wire; india-rubber, gutta-percha, cotton, silk or wool-covered wire; sleeves, paper jointing, &c., for P.M.G.'s Department. See "Official Notices" to-day.

Wigan.—May 29th. Corporation. H.T., three-core, paper and lead-covered, armoured feeder cable, transformer and switchgear. See "Official Notices" May 14th.

CLOSED.

Australia.—The following tenders have been accepted:—

P.M.G.'s DEPARTMENT, N.S.W.

240 miles twisted pair, rubber-insulated wire, £14 10s. per mile.—British Insulated & Helsby Cables, Ltd.

P.M.G.'s DEPARTMENT, VICTORIA.

Accumulator battery, Tudor type, for Perth radio-telegraph station, £322.—J. R. W. Gardam.

8 miles paper-insulated, lead-covered cable, 101 pairs, £392 per mile; 3 miles ditto, 89 pairs, £223 per mile.—British Insulated & Helsby Cables, Ltd.

VICTORIAN RAILWAYS DEPARTMENT.
(Electrical equipment of Melbourne suburban system.)

Track and line relays, £3,060.—British Pneumatic Railway Signal Co., Ltd.
Track resistance, £1,547.—McKenzie, Holland & Westinghouse Power Signal Co., Ltd.
Volt feeder cables, volt track cables and accessories, schedules rates.—British Insulated & Helsby Cables, Ltd.
Overhead equipment of permanent way and overhead transmission mains, schedule rates.—British Insulated & Helsby Cables, Ltd.
Hard-drawn copper wire, at £86 17s. per ton.—British Insulated & Helsby Cables, Ltd.

MELBOURNE, BRUNSWICK AND COBURG TRAMWAYS TRUST.

3-core H.T. cable, £1,183.—W. T. Henley's Telegraph Works, Ltd.
Overhead material, £4 554.—G. H. Bishop, British Insulated & Helsby Cables, Ltd.; Lascelles, Parrington, Australian General Electric Co.
Car equipment, £6 549 – Australian General Electric Co.
Sub-station equipment, £3,510.—Australian General Electric Co.—*Tenders.*

Bexhill-on-Sea.—The T.C. has accepted the tender of Messrs. Myers, Rose & Co. for 500 tons of Shipley Peas coal, for the electricity works, at £1 7s. 6d. per ton.

Bradford.—The Guardians have accepted the offer of Mr. Charles Bell, at £33, for installing electric light at the Westbrook Lodge relief station.

Dover.—The T.C. received the following tenders for six electrical vehicles for scavenging:—

Edison Accumulators, Ltd.	(accepted)	£6,760
General Vehicle Co., Ltd.		5,850
Wolseley's Motors, Ltd.		6,490

Glasgow.—The Tramways, Works and Stores Committee recommends acceptance of the following:—

Scrap copper cable, scrap motor field coils, scrap zinc.—P. and W. MacLellan, Ltd.
Scrap copper wire and bonds, scrap armature coils, scrap brass, brass dust, scrap lead, scrap rubber cable, scrap dry cells.—R. M. Easdale & Co.
Scrap lead-covered cable.—Trainer & Allison.
Brass turnings and borings, copper and mica turnings.—Pegler Bros. & Co., Ltd.
Cast-iron stopping-place sign posts.—D. King & Son; J. and A. Law, Ltd.
Two 500-kw. rotary converters.—British Westinghouse Co., Ltd.

The Corporation has placed a 12 months' contract for direct current house service meters with the British Thomson-Houston Co., Ltd.

Government Contracts.—The following tenders have been accepted during the past month by the Government Departments named:—

WAR OFFICE.

Telegraph pole arms.—Bullers, Ltd.; Siemens Bros. & Co.
Insulator bolts.—T. W. Lench, Ltd.; Chas. Richards & Sons.
Battery boxes.—Accumulator Industries, Ltd.; Houghton-Butcher Mfg. Co., Ltd.; Walters Electrical Mfg. Co., Ltd.
Insulator brackets, clips, pole, &c.—Bullers, Ltd.; T. W. Lench, Ltd.; Siemens Bros. & Co., Ltd.
Electric cable and wire.—T. Bolton & Sons, Ltd.; B I & Helsby Cables, Ltd; Callender's Cable and Construction Co., Ltd.; Henley's Telegraph Works Co., Ltd.; Hooper's Telegraph and India-Rubber Works, Ltd.; R. Johnson, Clapham & Morris, Ltd.; Johnson, Matthey & Co., Ltd.; R. Johnson & Nephew, Ltd.; London Electric Wire Co. & Smiths, Ltd.; Shropshire Iron Co., Ltd.; Siemens Bros. & Co., Ltd.; F. Smith & Co., incorporated in the London Electric Wire Co. & Smiths, Ltd; Ward and Goldstone.
Electric cells.—Siemens Bros. & Co., Ltd.
Resistance coils.—Gambrell Bros., Ltd.; Muirhead & Co., Ltd.; Nalder Bros. & Thompson, Ltd.; R. W. Paul; W. G. Pye & Co.; Reid Bros. Engineers, Ltd.
Telegraph commutators and vibrators.—Edison & Swan United Electric Light Co.; Gell Telegraph Appliances Syndicate, Ltd.
Electric cranes.—Babcock & Wilcox, Ltd.
Insulator cups.—Bullers, Ltd.; Taylor, Tunnicliffe & Co., Ltd.
Electric sets, &c.—Austin Motor Co.
Galvanometers.—Edison & Swan United Electric Light Co., Ltd.; India-Rubber, Gutta-Percha and Telegraphs Works Co., Ltd.
Insulators.—Litholite, Ltd.
Electric lamps.—Brimsdown Lamp Works, Ltd.; Cryselco, Ltd.; Efandem Co., Ltd.; General Electric Co., Ltd.; India-Rubber, Gutta-Percha, and Telegraph Works, Ltd.; Omega Electric Lamp Co., Ltd.; Siemens Bros Dynamo Works, Ltd.
Telegraph poles, steel.—Bayliss, Jones & Bayliss; Siemens Bros. & Co., Ltd.
Ditto, wood.—W. H. Beal; W. E. Chivers & Sons; Cutlans Steam Joinery Works; John Jaques & Sons, Ltd.; Maple & Co., Ltd.; H. H. Martyn and Co., Ltd.; T. and S. E. Merredew, Ltd.; Venesta, Ltd.; D. Wishart & Co.
Electric light switches.—General Electric Co., Ltd.
Telephone sets and parts.—London Electric Wire Co. and Smiths; Siemens Bros. & Co., Ltd.; Walters Electrical Mfg. Co., Ltd.; Western Electric Co., Ltd.; West London Scientific Apparatus Co., Ltd.
Works, services, electrical wiring, Codford, Sutton Veney and Warminster.—Edmundsons Electricity Corporation, Ltd.
Electrical wiring, Codford.—Tredegar, Ltd.
Electrical wiring, Sutton Veney.—Girdlestone & Co.
Electric light installation, Cannock Chase, Mansfield, Oswestry and Rhyl.—Ellis & Ward, Ltd.
Electric light installation, Richmond.—Cox-Walkers.

INDIA OFFICE: STORE DEPARTMENT.

Wireless apparatus.—Marconi Wireless Telegraph Co.
Cable.—Siemens Bros. & Co.
Searchlights.—Chance Bros. & Co.
Telephone parts.—Peel-Conner Telephone Works.
Wire.—B.I. & Helsby Cables, Ltd.; T. Bolton & Sons, Ltd.; White Cross Co.

POST OFFICE.

Telegraphic apparatus.—Cresde, Bille & Co.
Telephonic apparatus.—Automatic Telephone Mfg. Co., Ltd.; Brit. L. M. Ericsson Mfg. Co., Ltd.; Phœnix Telephone and Electric Works, Ltd.; Western Electric Co., Ltd.
Telephonic cable.—Johnson & Phillips; Pirelli-General Cable Works, Ltd.; St. Helens Cable and Rubber Co., Ltd.; Western Electric Co., Ltd.
Stoneware ducts.—Albion Clay Co., Ltd.; Doulton & Co., Ltd.; Oates and Green, Ltd.
Insulator spindles.—T. W. Lench, Ltd.
Insulating strips.—Millars Timber and Trading Co., Ltd.
Laying ducts, Stockport.—W. H. Worthington, Ltd.
Laying ducts and pipes, Belvedere to Hop Exchange, S.E.—F. G. Brumme'l.
Telephone Exchange equipment, Huddersfield.—Peel-Conner Telephone Works, Ltd.
Telephone Exchange equipment extensions, East (London).—Western Electric Co., Ltd. Salisbury.—Peel-Conner Telephone Works, Ltd.

Kingston-on-Thames.—The T.C. has accepted the tender of the Anglo-American Oil Co., Ltd., for 1,400 tons of fuel oil for Diesel engines for two years, at £3 5s. per ton.

London.—STEPNEY.—The Electricity Committee reports the purchase of 6,270 tons of coal for the electricity undertaking at prices ranging from 21s. 6d. to 24s. a ton, and has accepted the offer of Messrs. E. Foster & Co. for 3,000 tons of Bestwood Washed Peas, at 21s. 6d. per ton, in weekly quantities of about 60 tons.

HACKNEY.—The Electricity Committee recommends the B.C. to enter into a sole-use contract with the Electrical Apparatus Co., Ltd., for the supply of direct-current house type meters, as may be required, up to and including 25 amperes capacity, for one year.

Spain.—The Spanish Ministry of Marine has recently placed a contract with the Sociedad Espanola de Construccion Naval for the establishment of an electricity generating plant at the State Artillery and Projectile Works at La Carraca for lighting and power purposes.

Tasmania.—The Mount Lyell M. and R. Co., Ltd., has entered into a contract with the British Insulated and Helsby Cables, Ltd., for the sale to them of 250 tons of electrolytic copper (E.S.A. brand) monthly.—*Tenders.*

FORTHCOMING EVENTS.

Physical Society of London.—Friday, May 28th. At 8 p.m. At King's College, Strand. Papers on "Numerical Relations Between Electronic and Atomic Constants," by Dr. H. S. Allen; "A Method of Calculating the Absorption Coefficients of Homogeneous X-Radiation," by Mr. H. Moore; "Two Experiments Illustrating Novel Properties of the Electron Currents from Hot Metals," by Prof. O. W. Richardson, F.R.S.; "High Permeability in Iron," by Prof. E. Wilson.

Royal Institution of Great Britain.—Friday, May 28th. At 9 p.m. At Albemarle Street, W. Paper on "Engineering Problems of Mesopotamia and Euphrates Valley," by Sir J. Jackson.
Friday, June 4th. At 9 p.m. Paper on "Radiation from Exploding Atoms" by Prof. E. Rutherford, F.R.S.

Rontgen Society. Tuesday, June 1st. At 8.15 p.m. At Cancer Hospital, Fulham Road, S.W. Annual general meeting.

Thermal Insulation Tests of Electric Ovens.—A recent issue of the *Electrical World* contained some particulars of an investigation into the resistance to heat offered by five different kinds of oven wall, the oven in question being one used for electrical work at Harvard University, rectangular in shape with walls composed of asbestos board. A summary of results from the various tests is given below:—

Series	Nature of wall.	Deg. C. rise per watt input.	Thermal resistance ratios.	
1	Single shell	0·0254	1	
2	Double shell and simple air space	0·0410	1·62	
3	Double shell and cellular air space	0·0410	1·62	1
4	Double shell packed with cotton waste	0·0605	2·38	1·47
	Double shell packed with metallic wool	0·0779	3·07	1·9

The oven measured externally 63 in. × 41½ in. × 44 in., and internally, 56 in. × 34½ in. × 35 in. (approximately). It was found that after seven or eight hours from the commencement of heating, the rate of rise of internal temperature was sufficiently small to enable heat input to be taken as heat leakage without serious error.

The ovens provided with double walls, containing a simple air space between them, showed about 60 per cent. more thermal resistance to the escape of heat than a single wall, after a steady input for from seven to eight hours. Inserting a few horizontal wooden strips into the walls to break up the air space into compartments had no appreciable effect. Packing the hollow walls with loose dry cotton waste increased the double-wall thermal resistance nearly 50 per cent., and packing with a loose flocculent mineral substance nearly 90 per cent. The latter substance is procured in Indiana, and is fused and blown out with compressed air.

MAIN-MOTOR-STARTING SWITCHGEAR USED ON MODERN GERMAN SUBMARINES.

By NORMAN H. WOOD.

Owing to the exigencies of service to which a modern ocean-going submarine boat is exposed, and the fact that the machinery used to submerge the boat and propel it when submerged must be absolutely reliable, every effort is made to install apparatus which is effective and yet extremely simple.

On the surface a submarine is propelled by means of internal-combustion engines using crude oil, but when diving and running submerged the boat is driven by powerful electric motors and maintained at the desired depth by means of diving rudders or hydroplanes. Should, however, the main motors or their starting switchgear break down when the boat is running submerged, the diving action of the hydroplanes becomes nil, and the submarine, due to its reserve buoyancy, will immediately rise to the surface, thereby becoming a helpless target for the guns or ram of an enemy warship having a greater surface speed than itself.

These motors receive their current from a large storage battery usually placed amidships, and on modern German submarines the starting gear is of a very special type, the peculiarity being that the starting rheostat has been entirely eliminated. Experience has shown that these rheostats, even when immersed in oil, are very unreliable. Further, they occupy a large space and are very heavy.

The starting switchgear adopted by the German Navy is shown on the accompanying diagram.

The battery consists of 4 units of 60 cells each, arranged in series-parallel, and any one unit can be cut out by means of the isolating links. The cells are of a special type designed to withstand repeated momentary shorts without appreciable damage. The individual plates are of lead, the positives being of the high surface type whilst the negatives are pasted. The containers are of special vulcanite and are perfectly watertight, with a space of 60 mm. allowed between the lower edges of the plates and the container-bottoms to receive any mud that may accumulate. Grooved wood separators are inserted between the individual plates. The boat can assume an inclination of 25° in any direction without the acid running out of the containers.

The motors are of the shunt-wound double-motor type, fitted with interpoles and compensating windings. Each main motor has two armatures mounted on the same shaft, with two distinct but equally proportioned fields of eight poles each, whereby each armature at full load exerts half the total output, viz., 225 B.H.P.

The shunt fields are arranged in series, with a non-inductive resistance in parallel to provide a shunt discharge path when the current in the fields is switched off. The whole is mounted together to form one complete unit.

The starting switchgear is of the open type, and consists of quick-breaking change-over knife switches with auxiliary breaking-contacts, the whole being mounted on slate base-plates secured to angle-iron frames, with the connections taken off at the back.

The cables are lead-covered and armoured with interwoven flexible galvanised-steel wires.

Starting for the "Ahead" position is effected as follows:—

1. Switch A is moved up, switch D down, and the automatic overload cut-outs are inserted, when a current is immediately sent through the shunt windings. It is thus impossible to start up the motors on an open field.

2. Switch B is placed up and switch C down, when a very heavy impulse current, about 4,000 amperes, is sent through the two armatures in series, which at once commence to revolve. As this heavy current is only momentary, the time limits, which are set for about 3 seconds, prevent the cut-outs from operating.

3. By means of the shunt regulator the speed is increased to the utmost, when the shunt resistance is quickly cut out

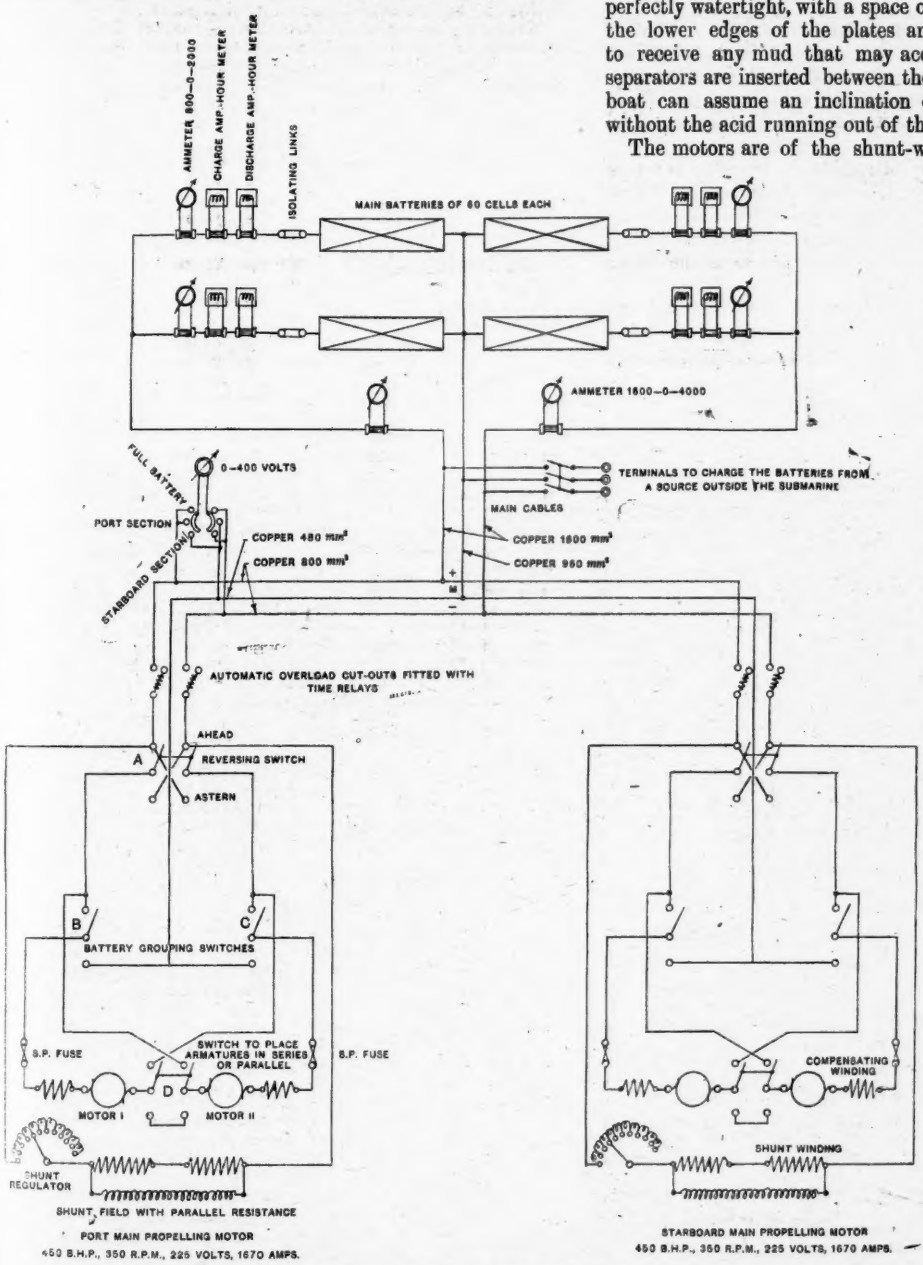


Diagram of Connections of Motor-Starting Switchgear.

and switch C placed up, whereby the armatures are in series across the full battery pressure.

4. By means of the shunt regulator the speed is again increased to the utmost, the shunt resistance quickly cut out and switch D moved up, thus placing the armatures in parallel across the full battery pressure.

The speed can now be adjusted at will by means of the shunt regulator. With this arrangement continuous regulation from 80 up to 350 R.P.M. is possible.

To reverse, switches A, B, C and D are opened, A is placed down and the other switchings are carried out as above.

As the time limits are set to operate at about 3 seconds the cut-outs are fully effective on a prolonged overload, but as an additional safeguard single-pole fuses are placed in the armature circuits.

This switchgear is usually placed in the boat as near the main motors as possible, and is provided with the necessary number of ammeters and ampere-hour meters of the mercury-motor type, to enable the officer in charge to read off the condition of the battery-units and, incidentally, to check their efficiencies.

The battery can only be charged when the boat is on the surface, the motors being driven as dynamos by the oil engines, but special terminals are provided to enable the battery to be charged with its sections in series or parallel from a source outside of the submarine, such as the parent boat or dockyard plant.

The capacity of the battery is so rated as to enable the main motors to give their full outputs for 1½ hours, thereby imparting to the boat a submerged speed of about 10 knots.

NOTES.

The Engineering Institutions' Volunteer Training Corps.—A meeting was held at the Institution of Electrical Engineers, on Thursday last week, to inaugurate the Engineering Institutions' Volunteer Training Corps, the formation of which was foreshadowed in these columns recently. Sir John Snell, President I.E.E., occupied the chair, and there was a good attendance.

The President announced that the Corps had been formed at the request of General Sir O'Moore Creagh, V.C., military adviser to the Central Association of Volunteer Training Corps, who had nominated Col. C. B. Clay, V.D., as Commandant, and he referred to the presence at the table of Mr. H. C. Gunton, Power Engineer to the Post Office and Commandant of the Post Office Engineering Volunteer Training Corps, and engineering adviser to the Central Association, whose experience in Territorial and Volunteer organisation would be valuable to them. He hoped the I.E.E. would form a nucleus which members of other Engineering Institutions would join; when the London unit had been organised, it was hoped that the Local Sections would form similar units in their respective areas. The Corps would have the cordial sympathy and support of the Council of the Institution, and it might be possible to contribute to its equipment from the Institution funds, should that be found necessary.

Col. Clay proposed that Sir John Snell, who had already done a great deal for the Corps, should be invited to become its Hon. Commandant, and this proposal having been heartily endorsed by the meeting, Sir John said he had great pleasure in accepting the appointment. He then vacated the chair, and Col. Clay read a letter from General Sir O'Moore Creagh, who, after expressing his pleasure on the acceptance by Col. Clay of the position of Commandant of the Corps, said:—

"The formation of engineering units is of the greatest importance if the Volunteer organisation is to be satisfactorily completed, and the members of your unit should be eminently suitable for carrying out work corresponding to the several branches of the work of the Royal Engineers. I understand that in addition to Telegraph, Telephone and Searchlight Detachments, you propose to furnish detachments that can manipulate emergency lighting sets, and also detachments that would be prepared to undertake emergency work in power stations in case of damage by bombs or other causes. I consider that the number of engineers who could be usefully employed on work of this nature is practically unlimited, and would be of the greatest service." Col. Clay proceeded to express his indebtedness to the assistance of Mr. Gunton, and read a letter received by the latter from Birmingham, describing the work that was being done by the Birmingham Electrical Volunteer Force, of which particulars were given in our issue of March 5th, 1915, p. 341. He stated that it was not proposed to limit membership to the engineering societies. Mr. Gunton had offered them the use of the Inns of Court Hotel for drill purposes, and, with his adjutant, Mr. G. F. Preston, would provide them with instructors from the Post Office Corps. Other places where they might drill were mentioned, including the Headquarters of the London Electrical Engineers (Territorials), where Col. Le Rossignol had kindly offered to afford them facilities.

Members of other volunteer corps could join by arrangement with their commandants for transfer; and it was thought that special constables might be able to join the corps. He regretted that as no form of attestation was permitted by the War Office, they could not share the work of the Regulars at present. An entrance fee of 5s. and a subscription of 5s. a quarter were suggested; the uniform would cost about 30s. They must begin with squad drill and company drill, and flag signalling; their technical work would embrace telegraphs and telephones, searchlights, trench work, wire entanglements, mining, temporary lighting, and, perhaps, wireless telegraphy. They might also be employed in semi-military functions, such as lighting camps, &c.

Mr. Gunton pointed out that in the early days the assistance of the Post Office Corps might be very useful to the new body, the former having obtained the loan of telegraphic apparatus and tools. It was important that eligible men who were not permitted to enlist should nevertheless be trained, ready to enter the Royal Engineers in a semi-trained condition in case of need. In his opinion the Volunteer movement encouraged recruiting for the Army, and there was plenty of scope for the corps.

Many questions were asked and answered, and it was agreed to commence drill on Wednesday next week, at 6.30 p.m. Saturday afternoons will also be taken, and other days will be arranged for as required. The meeting concluded with a hearty vote of thanks to Sir John Snell, Col. Clay, and Mr. Gunton for their work in forming the corps.

It was suggested during the meeting that many engineering firms would be glad of the opportunity to assist in equipping the corps with apparatus, and arrangements will be made to this end.

We are informed that drills will be held on Mondays, Wednesdays and Fridays at the Headquarters of the London Electrical Engineers, 46, Regency Street, S.W., starting on Wednesday, June 2nd.

Australia and Preference.—At a meeting held in April at Melbourne by the Victorian Chamber of Manufactures a communication was received from the Western Australian chamber asking for the views of the Victorian Chamber regarding the following recommendation from the New South Wales Chamber:—"That this Council heartily approves of the extended preference to the Mother Country given in the latest tariff, and urges upon the Federal Government the desirability of the Commonwealth also comprising trade reciprocity with the Dominions, and a fixed minimum surcharge of 25 per cent. for ten years upon all goods made in Germany. That the foregoing resolution be forwarded to the Associated Chamber of Manufactures of Australia for submission to the Federal Government."

According to the *Melbourne Age* the executive of the associated chambers was to consider the question contained in the New South Wales recommendations a few days later. The executive of the Victorian Chamber, together with the executive of the New South Wales Chamber, took steps at the beginning of this year to urge action somewhat in the direction indicated.

We are indebted for the foregoing information to an esteemed electrical correspondent in Victoria who is anxious that we should be kept informed in this country respecting the growing feeling in the different Australian States regarding the need for a prohibitive duty against German manufactures.

Heavy Mechanical Road Traffic.—The Departmental Committee recently appointed by the President of the Local Government Board to consider the law and regulations relating to the construction and use of road locomotives and heavy motor-cars in Great Britain has commenced to take evidence. Communications should be addressed to the Secretary of the Committee, Mr. R. J. Simpson, Local Government Board, Whitehall.

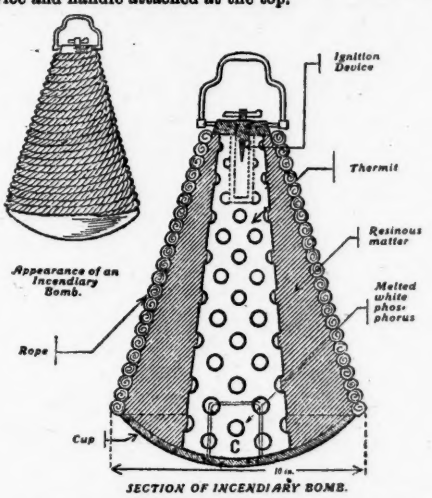
Industrial Electric Heating.—An Industrial Electric Heating Association has been formed at Toledo, U.S.A. Our American namesake quotes the following preamble to the constitution, showing the aims of the organisation:—"Recognising the opening of a new and heretofore undeveloped field in the electrical industry, the importance of which, and the possibilities for the development of which, are so great, and the present knowledge so small, it seems imperative that an organisation should be perfected to study and gather together all the available information on this great subject for the benefit of its members and of the industry at large and for the exchange of ideas and data."

Electric Light and Fans in German Trenches.—The *Times* special correspondent in Northern France states that the trenches taken from the enemy east of La Quinque Rue and Rue d'Ouvert were fitted with electric light and fans, and with mechanism worked by electric power for draining them. "The necessary power was obtained from electric plant at the coal-mines in the La Bassée area. In one trench our men profited for several hours by the electric light, but eventually the enemy severed the wires and so cut off the current."

Removal of Rust.—In a paper read before the Iron and Steel Institute at the recent annual meeting, Messrs. J. N. Friend and C. W. Marshall described experiments on the quantitative removal of rust from iron by chemical reagents. Various solutions were tried, but none was found that would remove rust without also dissolving some of the iron. One of the best reagents, acting quickly on the rust but very slowly on the iron, was boric acid; a saturated solution cleaned rusty plates in a day or two, after which very little loss in weight of iron occurred. A 10 per cent. solution of aluminium sulphate cleaned the iron in 24 hours and yielded an excellent metallic surface. Sodium citrate, which had often been recommended, acted very slowly, a 20 per cent. solution taking four days to clean the iron; it gave a beautiful surface, but the iron continued to dissolve during the whole period of immersion.

Air Raids and Fire Prevention. — An excellent "Warning" leaflet, No. 17A, has been issued to the public by the British Fire Prevention Committee, containing a description of the bombs used by enemy aircraft, and the best steps to take to deal with fires resulting from their use. Copies can be obtained from the Committee at 8, Waterloo Place, Pall Mall, S.W., on application. By kind permission of the Committee, we are enabled to reproduce a sectional drawing of the incendiary bombs, which, it will be seen, are exceedingly well calculated to ignite anything of an inflammable nature within their range.

The bomb, as a rule, is conical, corded round ; the base is a flat cup, on which a pierced metal funnel is fitted, having the ignition device and handle attached at the top.



SECTION OF INCENDIARY BOMB.

The funnel is generally filled with thermit, which upon ignition generates intense heat, and by the time of the concussion, has taken the form of molten metal at a temperature of over 5,000° F. The molten metal is spread by the concussion.

Outside the funnel is a padding of a highly inflammable or resinous material, bound on with an inflammable form of rope. The resinous material creates a pungent smoke.

There is generally some melted white phosphorus in the bottom of the cup, which develops nauseous fumes, and in some cases celluloid chippings are added, and occasionally a small quantity of petrol.

The best means of combating the flames produced by these infernal devices is to apply a stream of water from a series of buckets or a hose—single buckets of water are of little use, and sand has not the necessary cooling effect. Damped respirators should be worn to prevent breathing the pungent fumes. Gas and electricity supplies should be cut off at once.

Explosive bombs seldom cause fires.

Institution and Lecture Notes. — Diesel Engine Users' Association.—At the May meeting of the Association, it was agreed that a member unable to attend a meeting on any particular occasion should be entitled to nominate a deputy to attend in his place. The question of a suitable allowance to be made for depreciation of Diesel engine plant in connection with income-tax assessment was discussed, and its further consideration was adjourned. The subject of lubrication of Diesel engines was further dealt with. Information on several interesting points had been received from many of the members of the Association, and it was decided to extend the time for sending in returns from other undertakings and to ask for further information in certain cases. These returns will then be tabulated and circulated among the members only. The next meeting of the Association is to be held on Wednesday, June 16th, when the question of cracked pistons will also come up for discussion.

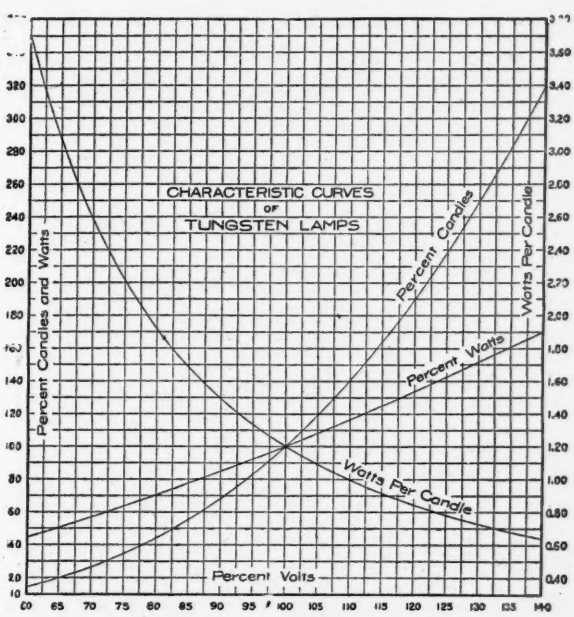
Institution of Electrical Engineers.—The annual general meeting of the YORKSHIRE LOCAL SECTION was held at Leeds, on May 12th ; Mr. T. Roles occupied the chair. The annual balance-sheet and report were presented and adopted. The following officers and members of the Committee were elected for the ensuing year :—Chairman, Mr. H. Hodgson Wright (Halifax) ; Vice-Chairmen, Mr. H. A. Neville (Wakefield), and Mr. W. Lang (Leeds) ; Hon. Sec., Mr. Jno D. Bailie (Leeds); Committee, Messrs. R. H. Campion (Dewsbury), W. M. Selvey (Sheffield), C. J. Jewell (Wakefield), P. J. Pybus (Bradford), J. E. Storr (Leeds), and E. C. Wallis (Leeds).

The annual general meeting of the contributors to the I.E.E. Benevolent Fund was to be held yesterday to receive the report and statement of accounts for 1914.

Association of Mining Electrical Engineers.—At a meeting in Dunfermline of the East of Scotland branch, office-bearers were appointed as follows :—President, Mr. W. A. Wilkie, Cardenden ; Vice-President, Mr. D. Beveridge, Kelty ; Secretary and Treasurer, Mr. Robert W. Peters, Lochgelly. A discussion took place on the "Use and Abuse of Oils on Mining Plant and Bearings of Electrical Machinery."

Electrically-Driven U.S. Warship.—The *Journal of Commerce* (Liverpool) states that the General Electric Co., of New York, will, according to an official announcement, supply the electric propelling machinery for the new U.S. battleship *California* for £86,200. The *California* is under construction at New York Navy Yard, which submitted an estimate of £126,200 for a steam equipment.

Tungsten-Filament Lamp Characteristics.—One of the greatest difficulties in photometry arises from the differences in the colour of light from different sources, which cause the personal element to assume excessive importance, as no two observers agree exactly in their judgment as to when two colours viewed in the photometer are of equal intensity. Hence in accurate work it is necessary to average a large number of observations made by different persons in order to arrive at a reliable result. By varying the temperature of the filament of a standard tungsten lamp, it is possible to obtain a wide range of colours which can be matched with the colours of the lamps under test, and when the candle-power of the filament corresponding with each temperature has been determined, the process of comparison is greatly simplified.



CHARACTERISTIC CURVES OF TUNGSTEN LAMPS.

This subject has been investigated by Messrs. G. W. Middlekauff and J. F. Skogland, whose results are given in the Scientific Papers of the U.S. Bureau of Standards. The authors find that all vacuum tungsten lamps (100 to 130 volts), over a wide range of wattage, have the same voltage-current-candle-power characteristics, independently of the method of manufacture, and the relations between these three factors can all be accurately expressed by one general equation of the form $y = A x^2 + B x + C$, where x = log voltage, y = log candle-power, log wattage, log current, or log watts per candle, and A, B, C are constants, the values of which depend upon the significance of y. The equation expresses the voltage-candle-power and the voltage-watts per candle relations to well within 0·3 per cent., and the voltage-wattage relation to well within 0·05 per cent. of the observed values over the range from 0·7 to 3·3 watts per candle, the latter limit extending beyond the watts per candle corresponding to colour match with 4-watt carbon lamps. It is therefore possible, after carefully standardising a tungsten lamp at colour match with 4-watt carbon primary standards, to calculate with a high degree of precision its candle-power, voltage and current at any desired watts per candle or colour within the range above-mentioned. Thus all measurements can be made at colour match without the use of colour screens.

To avoid the necessity of making tedious calculations, the authors give tables which enable the change to be made from one efficiency to another with an ordinary slide rule. The characteristic curves of lamps of sizes 25 to 100 watts at 100-130 volts, taking normally 1·2 watts per candle, are shown in the accompanying figure.

Coal Supplies Conference. — As a result of the National Conference on Coal Supplies to Gas and Electricity Undertakings, a deputation attended before the Coal Exports Control Committee, on the 20th inst., and laid the views of the Conference before it. The deputation consisted of Sir Corbet Woodall, Past President of the Institution of Gas Engineers and Governor of the Gas Light and Coke Co., Sir John Snell, President of the Institution of Electrical Engineers, Alderman Phillips, chairman of the Salford Corporation Gas Committee, Alderman Kay, chairman of the Manchester Corporation Gas Committee, Mr. Frank Bailey, chief engineer of the City of London Electric Lighting Co., Ltd., Dr. Charles Carpenter, chairman of the South Metropolitan Gas Co., Bailie Smith, chairman of the Glasgow Corporation Electricity Committee, Mr. Reginald Neville, M.P., chairman of the Brentford Gas Co., Mr. Hanbury Thomas, managing director of the Sheffield Gas Co., Mr. J. S. Highfield, chief engineer of the Metropolitan Electric Supply Co., and Mr. D. Milne Watson, general manager of the Gas Light and Coke Co.

Educational Notes.—UNIVERSITY OF LONDON.—The Senate last week resolved that the science department of Goldsmiths' College should be closed as from the end of the present session. It was also resolved that the East London College, previously admitted as a School of the University for limited periods, should be continued as a School of the University in the faculties of Arts, Science, and Engineering without further limitation of time.

BRISTOL UNIVERSITY.—The Council has decided to commence the erection of new buildings, for which a total sum of £220,000 has been presented by Messrs. G. A. and H. H. Wills.

MANCHESTER SCHOOL OF TECHNOLOGY.—Ten research scholarships in technology, value £80 to £50, with fees remitted, tenable during the session 1915-16, will be awarded on July 5th, 1915. Applications must be received by June 21st. Particulars can be obtained from the Registrar. The scholarships are open to graduates of any University in the British Empire, and to other persons possessing special qualifications for research.

Appointments Vacant.—Borough electrical engineer (£400) for West Hartlepool; charge engineer (30s.) for St. Albans Electricity Works. Particulars are given in our advertisement pages.

Fatality.—Sergt.-Major Thompson, 11th Welsh, at the Seaford camp, aged 35 years, who was, before he joined the Colours, in the clerical department of the Swansea electricity station, was returning to camp just before midnight recently when he was accidentally run over by a motor-car, receiving internal injuries from which he succumbed shortly afterwards.

Domestic Electric Service at Hendon.—In connection with their efforts to extend the domestic uses of electricity, the Hendon Electric Supply Co., Ltd. have arranged with Mrs. Maud Lancaster to give a series of demonstrations of various domestic electric appliances. The first of these demonstrations will take place on Tuesday next at St. Alban's Hall, Golder's Green. At 3.30 o'clock a lesson in cooking economical French dishes will be given by Mrs. E. Lewis, and it is after tea that Mrs. Lancaster will begin her explanations to ladies and their cooks.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The Luton Electricity Committee proposes to raise the salary of MR. R. HARDING, chief clerk, from £120 to £130 per annum.

The Bexhill-on-Sea T.C. has appointed MR. S. R. BURTON, senior shift engineer, to succeed Mr. R. N. Smith (who has enlisted) as consumers' assistant, at £2 per week.

Tramway Officials.—MR. F. FRESHWATER, manager of the Imperial Tramways Co., Ltd., Stockton-on-Tees, and his wife, have been presented by the staff with an inscribed solid silver tea and coffee service on the occasion of their silver wedding.

MR. JOHN CAMERON, JUN., a son of Mr. John Cameron, manager and secretary of Blackpool and Fleetwood Tramroad Co., has been appointed manager of Northampton tramways at a commencing salary of £350 a year. For some years Mr. J. Cameron, jun., has been borough electrical engineer of Northampton.

General.—The *Times* states that the Trustees of Columbia University, in the City of New York, have awarded the Barnard Gold Medal to Prof. W. H. BRAGG, F.R.S., Cavendish Professor of Physics in the University of Leeds, and his son, MR. W. L. BRAGG, Fellow of Trinity College, Cambridge, and a member of the College staff, at present holding a commission in the Leicestershire R.H.A. (T.F.), for their works on X-rays and crystals.

The Albert Medal of the Royal Society of Arts for the current year has been awarded to Prof. SIR J. J. THOMSON, O.M., D.Sc., LL.D., F.R.S., for his researches in physics and chemistry, and their application to the advancement of Arts, Manufactures, and Commerce.

MR. H. R. P. GIBBS, late chief electrical engineer in Mysore, and now the scientific head of the Tata hydro-electric scheme, has been appointed consulting electrical engineer to the Government of Mysore, the position of chief engineer being still in the hands of MR. S. G. FORBES.—*Indian Engineering.*

MR. ALEXANDER MACKENZIE has been appointed president of the Brazilian Traction, Light and Power Co., and its allied companies, to fill the vacancy caused by the death of Dr. F. S. Pearson through the *Lusitania* disaster. Mr. Mackenzie has been closely associated with the Rio de Janeiro Tramway, Light and Power Co. and the Sao Paulo Tramway, Light and Power Co. from their inception, and for many years acted as general and legal representative of the companies in Brazil.

The Prime Minister has written to Sir Edgar Speyer, informing him that the King is not prepared to accept his resignation of the marks of distinction received in recognition of public services and philanthropic munificence. Mr. Asquith says he has known Sir Edgar long and well enough to estimate at their true value the "baseless and malignant imputations" upon his loyalty to the British Crown. Sir Edgar left Liverpool on Wednesday to spend a brief holiday in the States.

The *Electrical Review and Western Electrician* states that MR. THOMAS A. EDISON has been voted the American who has done the most to benefit mankind, and is to receive the Civic Forum Medal of Honour for distinguished public service. The medal, which was established to give recognition upon the part of the rank and file of the American people to that one of their countrymen who in ways of peace performed some signal public service, was first awarded last year, Colonel George W. Goethals being the recipient.

Obituary.—Reuter's Paris correspondent announces the death of M. PIERRE MARTIN, the inventor of the Siemens-Martin process of manufacturing steel. The Iron and Steel Institute conferred the Bessemer Gold Medal upon M. Martin last May.

M. GEORGES DARY.—We regret to record the death of M. Georges Dary, who was for many years associated with our contemporary *L'Electricien*, of Paris, which has not yet been able to resume publication owing to the absence of M. Montpellier, the proprietors, and all the staff on military service. M. Dary, who has been an occasional, but valued, contributor of the ELECTRICAL REVIEW in recent years, underwent an operation a short time ago at Toulouse. It was his intention, immediately after recovery, to place before our readers his views regarding the future prospects for electrical industry in France, but, unfortunately, it has been willed otherwise. He had two sons serving with the French Forces, one of whom was, we believe, taken prisoner some months ago. M. Dary's sentiments were always most cordial towards this country, and he believed most completely in the ultimate crushing of the enemy by the Allies. We tender to the family our sincere sympathy in the great loss that they have sustained.

NEW COMPANIES REGISTERED.

Highfield Syndicate, Ltd. (140,408).—This company was registered on May 20th, with a capital of £5,000 in 4,875 cumulative preferred ordinary shares of £1 each and 5,000 deferred ordinary shares of 6d. each, to adopt an agreement with F. W. Highfield, to develop and turn to account the patents referred to therein, to carry on the business of precipitating or condensing dust, metallic or other particles, fume vapours, and volatilisation products, electric and general smelting and refining, etc. The subscribers (with one preferred ordinary share each) are: F. H. Haviland, Thurnham, Lowther Road, Bournemouth, solicitor; W. A. Maslom, 15, Old Christchurch Road, Bournemouth, solicitor. Private company. The number of directors is not to be less than two or more than seven; the first are F. H. Haviland and F. W. Highfield. Qualification, £100 preferred ordinary or £3 10s. deferred ordinary shares. Solicitor: W. A. Maslom, 15, Old Christchurch Road, Bournemouth.

Ecco Battery, Co., Ltd. (140,389).—This company was registered on May 19th, with a capital of £12,000 in £1 shares, to adopt an agreement with T. Hill Jones for the acquisition of the property referred to therein, to carry on the business of electrical engineers, agents, factors, warehousemen, manufacturers, dealers, importers and exporters, etc. The subscribers (with one share each) are: M. Wolff, 19 & 21, Fore Street Avenue, E.C., merchant; A. J. Mardlen, 84, Milton Street, E.C., merchant. Private company. The number of directors is not to be less than three or more than six; the first are M. Wolff, A. J. Mardlen, M. H. Goldstone, T. H. Joner, T. M. Jones, and T. A. Taylor (all permanent). Qualification, 500 shares. Remuneration, £50 each per annum. Registered office: Invicta Works, Bow Common Lane, E.

General Cable Manufacturing Co., Ltd. (140,379).—This company was registered on May 18th, with a capital of £6,000 in £1 shares, to carry on the business of cable manufacturers' merchants, factors, dealers, agents, purchasers and vendors, in England and elsewhere, etc. The subscribers (with one share each) are: Hans Ochsenbein, 15, Garlick Hill, E.C., cable merchant; J. Wright, 2, Wood's Villas, Swanley, Kent, engineer. Private company. The number of directors is not to be less than two or more than five; the first are J. Wright and G. E. Pullen. Qualification, £5. Remuneration of chairman, £10 per annum; of others, £5 each per annum. Solicitors: Sparks, Whitehouse, Russell & Co., 32, Walbrook, E.C.

Anglo-Chinese Engineers' Association, Ltd. (140,361).—Registered May 17th, by Stileman & Co., 110, Leadenhall Street, E.C. Capital £53,750 in 5,000 six per cent. cumulative preference shares of £10 and 75,000 deferred shares of 1s. each. Objects: to carry on in China or elsewhere the business of ironfounders, mechanical engineers, manufacturers of agricultural instruments and other machinery, tool makers, metal workers, boiler makers, millwrights, machinists, iron and steel converters, smiths, builders, metallurgists, electrical and water supply engineers, gas makers, agents, merchants, shipowners, carriers, manufacturers of and dealers in machinery, implements, rolling stock, and hardware of all kinds, etc., and to adopt agreements with A. J. Moore-Bennett. The signatories (with one deferred share each) are: S. Denison, Hunslet Foundry, Leeds, engineer; A. J. Moore-Bennett, St. Winifred's, Lordship Lane, S.E., consulting engineer. Private company. The first directors (to number not less than two or more than 12) are A. J. Moore-Bennett, J. Downs (Rose, Downs & Thompson, Ltd.), Hull; S. Denison, H. J. Ward, 10, St. Swithin's Lane, E.C., and W. W. Gibbs (Gwynnes, Ltd.), Hammersmith Iron Works, Hammersmith, W. No qualification necessary. Remuneration (except managing director) as fixed by the company. Registered office: 9 & 10, Pancras Lane, E.C.

Holme Electric Co., Ltd. (140,393).—This company was registered on May 19th, with a capital of £1,000 in £1 shares, to carry on at Holme and elsewhere in the West Riding of Yorkshire the business of an electric light company in all its branches. No share shall be allotted or transferred to a person who is not either (1) a ratepayer of the Urban District of Holme, or (2) a resident within the said district, or (3) an owner of property within such district. The subscribers (with one share each) are: C. Tinker, Lane Head, Holme, near Holmfirth, manufacturer; H. Howard, Lane Head, Holme, near Holmfirth, farmer; A. Howard, Lane Head, Holme, near Holmfirth, surveyor; H. Batty, Lane Head, Holme, near Holmfirth, teamer; J. Batty, Lane Head, Holme, near Holmfirth, farmer; P. Haigh, Lane Head, Holme, near Holmfirth, warper; Hubert Hadfield, Lane Head, Holme, near Holmfirth, farmer. Minimum cash subscription, £800. The first directors are: C. Tinker, H. Howard, C. Beardsell, Harry Hatfield, and R. Calvert. Registered office: Council Offices, Holme, near Huddersfield.

Halliwell and Co., Ltd. (140,421).—This company was registered on May 21st, with a capital of £2,000 in £1 shares, to carry on the business of electricians, mechanical engineers and manufacturers, workers of and dealers in electricity, motive power and light, etc. The subscribers (with one share each) are: H. Halliwell, Hill Crest, Singleton Road, Kersal, Manchester, engineer; J. R. Halliwell, 3, Moss Bank Road, Crumpsall, near Manchester, electrical engineer. Private company. H. Halliwell is permanent governing director. Qualification, £100. Registered office: 43, Thomas Street, Manchester.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Foster and Pullen, Ltd.—First mortgage debenture, dated May 8th, 1915, to secure £500, charged on company's undertaking and property, present and future, including uncalled capital, registered. Holder: G. Grange, 12, Guy's Cliffe, Undercliffe Lane, Bradford. A memorandum of satisfaction in full on May 4th, 1915, of first mortgage debenture dated May 4th, 1910, securing £500, has also been notified.

Coast Development Corporation, Ltd.—Second mortgage, dated May 3rd, 1915, to secure £3,000, charged on the electric lighting station, Walton-on-the-Naze, and goodwill of business carried on there. Holders: Sir Thomas S. Cave, K.C.B., Kilworth, Woking, and others.

Wycombe Borough Electric Light and Power Co., Ltd. (53,133).—Capital, £50,000 in £5 shares. Return dated March 24th, 1915. 8,000 shares taken up; £40,000 paid. Mortgages and charges, £40,000.

Brilliant Sign Co. (1907), Ltd.—Charge on certain book debts due from debtors in Belgium, dated May 6th, 1915, to secure £1,000. Holders: Capital & Counties Bank, Ltd., 39, Threadneedle Street, E.C.

Universal Cheap Cables, Ltd.—Mortgage, dated May 10th, 1915, to secure £50, charged on certain freehold land at Norman's Bay, Sussex. Holder: O. N. Lake, 219, Tufnell Park Road, N.

British Battery Co., Ltd. (137,905).—Debenture, dated May 17th, 1915, to secure £700, charged on the company's undertaking and property, present and future. Holders: A. H. Rose and T. A. Rose, 39, Beech Street, Barbican, E.C.

CITY NOTES.

Callender's Cable and Construction Co., Ltd.

Mr. T. O. Callender (managing director) presided at the annual meeting, held on May 20th, at Hamilton House. He first apologised for the absence of Sir Fortescue Flannery (Chairman) through illness. The capital expenditure was £14,624, against £16,119 last year. It had not been necessary to spend so much as in 1913, but still they had to make some fairly considerable extensions at the factory. On the other hand, they had slightly raised the depreciation, which now stood at £9,967, as against £8,900 in the previous year. Cable drums, contract plant, etc., stood at £40,443. They had found it necessary to modify in some respects the arrangement of their accounts, owing to the large amount of contract plant which they had to purchase in connection with the important telephone contract which they secured from the Government. Last year the item stood at £21,097. Goodwill and patents were nil, as the item had been entirely written off. The stocks of raw material were £44,811, or £22,000 down as compared with the previous year. They had been able to dispose in the ordinary course of their business of some of the stocks they had, although they would gladly, if possible, have increased certain of the items which, owing to the war, they could not get, and this during the early part of the present year caused them some inconvenience. It was common knowledge that owing to transport and other difficulties and the requirements of the Government metals, and especially copper, had been exceedingly difficult to obtain, and practically all of the reduction in the stock of raw materials was due to the inability to get the materials as promptly as they wished. That position was now improved, although railway and sea transport was still being carried on with the greatest possible difficulty. On the other hand, manufactured stock had considerably increased, and now stood at £101,145, against £68,307 in the previous year, or an increase of £32,000. That was due, again, considerably to the difficulty of transport, for it happened that at the moment the balance was struck they had a lot of stuff awaiting shipment, and the increase had long since been fully disposed of. If they put the two items or raw materials and manufactured goods together, which was a fair way of looking at it, the total was £145,956, against £135,834 in the previous year, or a difference of only £10,000. The expenditure on contracts in course of execution, etc., was £72,325, as against £137,146 last year, but this was no more than they expected, for at the end of last year, when their books closed, no new contracts were being placed, and they were simply working out the large contracts they had then in hand. So far as contract business was concerned, it was quite evident that owing to the war and the restrictions imposed on municipalities by the Treasury that there could not be the same amount of contract business for electric mains in 1915 or in the latter part of 1914 as there was in previous years. Therefore, the reduction in their contracts, although they were sorry to see it, was no more than they could have expected, and was, indeed, much less than might have been anticipated. Their debtors were £265,572, as against £219,000, an increase of £45,000. That probably might fairly be set against the decrease in the contract work, because the amount of business they did in 1914 compared most favourably with that of the previous year, both in volume and profit, in spite of the war. In fact the profit figures were conclusive evidence that they must have done a much larger business than in the past, which really was the case. Their retention money, which was always a large item in the balance sheet, was £105,940, against £80,190, but as nearly the whole of the increase was owing by the Government they need have no misgivings. During the latter part of the year, when they had the greatest possible anxieties as to the way their business might be carried on, they found a surprising amount of assistance from the municipalities and Government in the prompt way in which accounts were settled. In August they were in great anxiety as to what the outcome of the situation would be, but they had surmounted these difficulties, and, like other people in the country, had come wonderfully well out of it. It was only right, however, that he should testify to the loyal assistance they had had from customers on their books, many of whom had been their friends and had stood by them ever since the company started in business. On the other side of the balance sheet, many of the figures were practically identical with those of last year. Bills payable, however, were £96,360, against £150,405; but on the other hand their creditors were £214,694, against £166,519. Taking the two figures together, they were much the same as in 1913. Turning to the profit and loss account, they had to deal with the handsome sum of £162,254, which, considering the state of affairs, was a very reasonable profit for the company to have made. It compared with £159,234, or an increase of £3,020. The Chairman went on to explain that the item was arrived at in rather a different way to that of previous years, and the sum shown as profit would have been a good deal more had they followed the usual custom. The £162,254 was profit after certain commission had been deducted for 1914, which was not the case in 1913. The item of £867 for allowances to staff on active service by no means represented what would be their contribution in the current year, and they still had men leaving the company's service to join the Forces. None of them would, however, grudge for one moment such contributions. No fewer than 300 of the staff and of the permanent men had joined the Colours, and, in addition, a large number of men who were in the company's service at the outbreak of war, but who were not in permanent service, had also joined. In all, between 600 and 700 men who were with Callender's on August 4th had gone. That drain had, of course, been serious and caused them inconvenience, but they could hardly object to it under the circumstances. They had always considered it their duty to employ as many Naval Reserve men as possible, and they required handy and reliable men who knew what discipline was; and, of course, when war broke out they melted away like snow. Repairs and maintenance of plant and buildings amounted to £14,204. A considerable part of that upkeep was really in the way of depreciation, because when any of their plant became old-fashioned they simply dealt with it straight away. The net profit was £98,692, as against £91,861. They saw no reason for altering their policy of carrying forward substantial sums, especially in these times of serious trouble. The result had only been arrived at after a good deal of trouble and worry. At first none of them knew where they would be, and they had to grope along for some months, and they were only now getting their business into proper order. The amount of business generally in the company decreased in 1915, but not to the extent that they might reasonably have expected. The large telephone contract on which they had been engaged had been suspended, but they hoped on the conclusion of war it would be renewed with much new work in addition. The re-arrangements necessary owing to the war had been done with all possible expedition, but it was not easy to take a factory designed for economically manufacturing cables and turning it into use for something else. They had a large engineering business in addition, and they had been able to take work offered to them by the Army and Navy, and especially by the Navy, with whom they had always been in close touch. They had done considerable work for the Admiralty, and it was a great satisfaction for them to know that in several of the serious operations which had taken place their work had been reported on, and they had every reason to be satisfied with the outcome of it. The Chairman proceeded to speak in eulogistic terms of the work of the British Navy, and remarked that the work they were now carrying out necessarily could not be so profitable as that which they dealt with in the ordinary course of business. Still, they would look after the interests of the shareholders to every extent which was proper and right, and he hoped they would not be unduly depressed when they came before them with the current year's accounts.

Mr. J. Varley seconded the motion, and the report was adopted without discussion.

On the motion of Mr. J. Stewart Bain a hearty vote of thanks was passed to the board and staff.

Mexico Tramways and Electric Companies.

Circulars have been issued to the bondholders and shareholders of the Mexico Tramways Co., the Mexican Light and Power Co., Ltd., the Mexican Electric Light Co., Ltd., and the Pachuca Light and Power Co. by the directors explaining the position of affairs. As printed in the *Financier*, the circulars state that since the date of the issue of the last annual reports of the companies the financial and political conditions in Mexico have grown steadily worse. At the present time the affairs of the country are in a state of chaos, and practically all business is at a standstill. The directors and officials have given the most anxious thought to the situation and used every possible endeavour to protect the shareholders' interests. As the affairs have reached a climax and the control of the tramways has been taken out of their

hands, they desire to lay the position fully before them. The existing situation does not arise from a financial weakness on the part of any of the companies. They have all had a prosperous existence from their inception, and, but for the political interference, there is no reason to believe that they would not still be earning not only the interest on their bonds, but satisfactory dividends for the shareholders. The credit of Mexico has steadily fallen. Power has been held now by one faction, now by another, and each new authority has issued large amounts of paper money, with the result that the value of the currency has depreciated, so that at the present time the rate of exchange is not more than 5d. to the peso, instead of 25d., the normal rate. As millions of paper pesos are already in circulation—and the amount is likely to increase rapidly—a still further drop in exchange may be expected. The Tramways Co., however, was obliged to accept this paper currency for fares, with the result that a large proportion of the gross receipts was useless for buying exchange on London and Toronto for the purpose of paying coupons or purchasing materials for maintenance and current operation. It is now practically impossible to communicate (except with great delay) with the officials of the company in Mexico, but the latest information received states that when Carranza's representative was recently driven from the City of Mexico by Zapata he took with him the "controllers" off the cars, thereby rendering them unfit for service. As a result, all traffic has ceased. The board have made numerous protests to the authorities in Mexico, and have repeatedly filed protests against the actions of the Mexican leaders through the representatives of the British Government in Mexico, the Department of the Secretary of State in Washington, and the Foreign Office in London. The authorities have not up to the present taken over the control of the businesses of the Mexican Light and Power Co., Ltd., the Mexican Electric Light Co., Ltd., or the Pachuca Light and Power Co., and the physical condition of the properties of these companies has been very little injured. It has been necessary, however, to grant a large increase in wages, with a consequent decrease in net revenue, and as the income of the businesses is largely received in paper, there is practically no available surplus after providing for the maintenance which is absolutely necessary to keep the businesses in operation. The board at the present time are conferring with the trustees for the bondholders as to what further steps, if any, should be taken to protect the bondholders' interests. The board feel, however, that the future of the enterprises must necessarily depend upon the development of the political conditions in Mexico and the future attitude of the United States Government towards that country.

Kalgoorlie Electric Power & Lighting Corporation, Ltd.

Mr. E. Pope, presiding at the annual meeting, held on Tuesday, said that the general business of the company had been maintained throughout the year, and the result was well up to the average of previous years. There was some alteration in the items of the balance sheet—the reserve established for depreciation and renewals having been written off. This fund had been used chiefly for purchasing new up-to-date plant to take the place of the original plant. The old plant had been, and was being, maintained in efficient running order, and formed a valuable stand-by plant; but owing to the progress in engineering practice it was somewhat out of date and could not be operated at a cost low enough to yield a satisfactory profit on the price at which they now had to sell current. It had, therefore, depreciated in value, and it had become advisable to write off the fund for depreciation and renewals, the cost of the plant. Out of the profit for the year £7,000 had been set aside for the redemption of debentures. As some holders might have been compelled to realise, and possibly, owing to the war, there might not have been much market, they decided to protect the holders as far as possible by buying for the company if debentures were offered. With part of the money reserved for the redemption of debentures they had subscribed for £5,000 of the war loan. There would be some increase of their operating costs during the current year, but they had reason to think that in the final result they would nearly, if not quite, maintain their average moderate profit. So far as the year had gone, they had done a little better than in the corresponding period of last year. Some of their contracts had been recently renewed, and the aggregate of current sold showed but little variation. As they knew, a great deal of the engineering capacity of the country was engaged on Government work, and whilst the war lasted they might at any time, if they had a breakdown, find it impossible to get a supply of new plant, or even of material. Fortunately, they had a fairly large stock of spare parts and supplies. Still, any breakdown, even on a moderate scale, might necessitate running their stand-by plant for a considerable time, and this would seriously reduce their profit. This was a risk they could not altogether avoid. They could congratulate themselves that the scene of their operations was outside the area of actual conflict, and that their loss was not likely to be great. At their last meeting they discussed the project of conserving all cash possible for the purpose of paying off the existing debentures, and that for this purpose they should pay the preference shareholders their full dividend in second debenture bonds, bearing 6 per cent. interest. They had come to the conclusion that it was better to go on as they were for the present. They were of opinion that the debentures would be handled and dealt with fairly equitably and to the satisfaction of the holders when the time came. No debenture holder need fear for either his interest or his capital. The Kalgoorlie goldfield, upon the life of which they depended, would be operated at a profit long after the last of their existing debentures were paid off. In conclusion, the Chairman expressed the satisfaction of the board at the services of Mr. Crocker, their general manager, and the staff he controlled; of Mr. Batley, who represented Messrs. J. G. White & Co., their consulting engineers; and of the secretary, Mr. H. J. Dixon.

Mr. G. C. Howard seconded the motion, and the report was adopted.

Companies Struck Off the Register.—The following companies have been struck off the Register and are accordingly dissolved:—

Alkaline Accumulators (Paul Gouin).
Anglo-Brazilian Power and Shipping Corporation.
Beam Co. (British Electrical and Mechanical Co.).
Blast-Furnace Power Syndicate.
Coal Substitute.
County Electric Traction Co.
Electric Batteries and Carbons.
Leeds Electric Co.
Schenfe'd Universal Oil Filter Co.
Southwold Electricity Works.
Witney Electric Supply Co.

Cuban Telephone Co.—The gross income from rentals and miscellaneous sources aggregated over $1,200,000 during 1914, and after deducting all costs of operation, taxes and general expenses, and providing ample depreciation reserves, the net balance of operating income amounted to over $559,000. The company paid during the year two quarterly dividends on preferred stock, totalling $60,000, and one quarterly dividend on common stock, amounting to $62,500. Nearly $700,000 of the accumulated net cash surplus has been used for the purpose of carrying on construction work. The general financial stringency has made impracticable the further placing of securities, hence the action of the directors in not declaring the dividends which have been earned.—*Financial Times.*

Anderston Foundry Co., Ltd.—The accounts for the year to March 31st show that £5,321 was brought in, and the profit, after providing for depreciation and income-tax, was £30,707 (against £40,984). It is now recommended that there should be paid a final dividend of 15s. 6d. per share (making 20s. per share for the year), less tax, the same as for the previous year. £2,500 is placed to reserve.—*Times.*

Stratford-on-Avon Electricity Co., Ltd.—Mr. G. M. Bird presided at the annual meeting held on the 14th inst. He regretted that it had been necessary to pass the dividend on this occasion. They had hoped to steadily progress until 5 or 6 per cent. was paid, but the year had brought a set-back. There were advances in fuel and wages, and several breakdowns on the mains which occasioned considerable expenditure for repairs, though other repairs and maintenance charges were reduced. He did not think there would be a big advance in anthracite coal. Unfortunately they could not increase the price of electricity, as their agreement with the Corporation bound them not to exceed 5d. per unit for lighting. The Corporation had increased the price of gas by 4d per 1,000, and they might be disposed to allow the company to advance their rate per unit, and if it was found that the present price could not be made to pay they might approach the Corporation. Mr. Priest seconded the adoption of the report.

Doulton & Co., Ltd.—A financial daily states that after paying 5 per cent. on the preference shares for the year ended December, 1912, £31,626 is to be carried forward.

Veritys, Ltd.—The directors, according to the *Financial Times*, recommend a dividend at the rate of 6 per cent. per annum on the ordinary shares for the half-year, making 6 per cent. for the year, carrying £1,001 forward.

Havana Electric Railway, Light and Power Co.—The accounts show the business for 1914 in comparison with 1913 was as follows:—Gross earnings, $5,396,713, against $5,417,054; operating expenses and taxes, $2,595,321, against $2,612,952; net income, $2,801,392, against $2,804,101. Dividends paid during the year, 6 per cent. on preferred and 5 per cent. on common stock.

Lima Light, Power and Tramways Co.—The report states that the net profit for 1914 was £p120,259. There is to be put to reserve and redemption fund, £p28,867; to reserve for bad and doubtful debts, £p10,000; to extraordinary repairs, £p16 814; to provision for losses in exchange, £p7,000; and the dividend 1 per cent. (in respect of the first quarter of 1914, since when no dividend has been paid), £p13,498; leaving £p50,077 to carry forward.

United River Plate Telephone Co., Ltd.—The gross earnings for 1914 were £630 652, less maintenance and other charges in Argentina and London, £468,846. After paying the preference dividend and the interim dividend on the ordinary shares, there remains £103,206, plus £6 357 brought forward; £2,000 is to be put to staff provident fund, £20,000 to reserve, and a final dividend of 5 per cent. on the ordinary shares, making 8 per cent. for the year, is recommended, leaving £6,563 to be carried forward. The directors refer with regret to the death of Mr. D. Smith, for many years secretary and latterly managing director. Annual meeting held yesterday.

Anglo-Argentine Tramways Co., Ltd.

For the year 1914 the gross receipts were £2,850,995, less working expenses £1,880,996, leaving £969,999. After adding interest on investments at £13,421 brought forward, and deducting debenture, loan, and preference interest and charges, £917,388, there remains £96,409, which is to be carried forward as, having regard to the decrease in the traffic receipts for the current year as compared with those of 1914, and the uncertainty of the outlook for the remainder of 1915, the directors have decided not to recommend any dividend on the ordinary shares. The average number of miles of surface line open for traffic working throughout the year has been 361, against 348 in 1913. The extension to Caballito of the first subway line from Plaza Mayo to Plaza Once was opened in April as far as Rio de Janeiro Station, and the entire line on July 1st, the whole length of the subway open, with extensions, being 4½ miles. The construction of the second subway line between Retiro and Plaza Constitución, which under the company's municipal concession was to be completed by December 31st, 1914, has been postponed under the authorisation of the Municipality.

Mr. G. Pedriali, the general manager, as usual makes a detailed report on the position of affairs. Business was bad from the commencement of the year 1914. The local crisis of the previous year continued, failures being frequent, and many large and important firms involved. Land speculation and the restriction of credit by the banks were the causes. The war came as the last straw, and absolutely paralysed everything for the rest of the year. The effects are still felt, in spite of the excellent harvest prospects. Excess of emigration over immigration amounted to 61,103 for 1914. The tramways were, of course, affected, as the following returns show, and the traffic receipts were diminished, notwithstanding the additional facilities offered by the subway:—

		Surface.	Subway.	Total.
Passengers carried	1913	340,014,573	2,125,849	342,140,422
" "	1914	303,500,792	28,514,462	332,015,254
Decrease per cent.,	1913	10.7	—	2.9
Car kilometres run	1913	81,740,322	165,104	81,905,426
" "	1914	78,072,894	3,556,177	81,629,071
Decrease per cent.,	1913	4.5	—	0.3

The total rolling stock increased from 2,603 to 2,676. The rolling stock was maintained at a considerably reduced cost, but 1914 was not a year for records, as heavy and continuous rains caused floods, with consequent detrimental effects upon the car equipments. Approximately, 21 km. of new track were brought into service, and reconstruction of permanent-way track has been completed or taken in hand in several directions. The severe drop in receipts on all lines renders comparisons of value impossible, otherwise it would have been interesting to draw conclusions in regard to the effect of the opening of the subway. Many lines have already been favourably affected, and have become valuable feeders to the subway. Energy consumption per car km. has been further decreased, the average decrease being 17 watt-hours per car km. run. This is a result of the improved condition of the rolling stock and of the careful attention given to the manner of driving. The gross receipts were £2,847,471, a decrease of £115,673, but they were still in excess of the 1912 figures by £94,399. The report gives figures showing the continuous fall that took place in receipts for the subway during each of the months from July to December, and on the surface lines during the whole year. Import and export trade was seriously affected by the war; freights on coal had oscillated from 11s. to 25s. per ton to Buenos Aires; and Cardiff coal of best quality was extremely difficult to purchase.

The average consumption of current per car km. on the surface lines was 613 watt-hours in comparison with 630 watt-hours in 1913.

On the subway in 1914 the average consumption was 1,810 watt-hours per car km.

The 12 per cent. additional municipal tax for 1914 amounts to $82,131.

Passengers per car km. (surface lines) have decreased from 4.16 in 1913 to 3.89 in 1914.

Expenditure per car km. (surface lines) have been reduced from 24.87 cents to 23.06 cents. This is due partly to the reduced 12 per cent. tax for 1914, working out at over half a cent less per car km., and partly due to economy in maintenance of cars, track, overhead line and buildings, equal .87 cents.

Expenditure for the surface lines was £1,572,079, a decrease of £202,867; and for the subway £129,887, an increase of £121,849. The net receipts decreased by £148,901 for the surface lines and increased by £114,246 for the subway. The gross receipts, therefore, show a decrease of £115,673, or 3.90 per cent. The expenditure decreased by £81,018, or 4.54 per cent., and the net receipts by £34,655, or 2.94 per cent. The percentage of expenditure on receipts has been 59.77 per cent., compared with 60.17 per cent. in 1913. Expenditure has been kept at a minimum, and important economies have been effected in all sections. From the labour point of view, the year in Buenos Aires has been the quietest ever experienced, owing to the abundance of labour offering. Mr. Pedriali, referring to the subject of prospects, says:—

The forecast contained in my report for 1913 was, of course, completely upset; in the first place owing to the fact that the local crisis, which had been threatening for a whole year, became suddenly worse about the month of April, 1914, and then matters were thrown all out of gear by the outbreak of the European war. The past year has been a great lesson to everybody in this city. Whereas formerly money was plentiful and the tendency was to spend generously, now everybody is economising, and even though business may have slightly improved since the new year, there is no doubt that the spirit of economy is still in the ascendency, so that our receipts are, if not still dropping, at any rate at a complete standstill. Under these circumstances, it is extremely difficult to even make a guess at what our receipts should be during 1915. Unfortunately, however, there is no doubt that we cannot expect any increase whatever on the year 1914, and in all probability there will be some decrease.

The annual meeting was held yesterday.

West London and Provincial Electric Supply Co., Ltd.

Mr. Harry Kahn presided over the annual meeting, at 14, Ironmonger Lane, E.C., on May 19th. He said that the success of the Chiswick Electricity Supply Corporation spelt the prosperity of the company. Out of the available balance, £3,337, they were paying 6 per cent. on the preference shares, carrying forward £393, as compared with £26 brought in. The balance sheet was now a perfectly clean one, the item preliminary expenses £483, having been written off in the previous year. In regard to the Chiswick Electricity Supply Corporation, which supplied Chiswick and Aberystwyth, in view of war conditions there was every reason to be satisfied with the results submitted. During the year the number of consumers had increased by 111 to 2,717, but owing to the lighting restrictions the increase in consumers had only partly made up for the reduced consumption for shop-front and similar lighting, the total revenue being down from £19,440 to £19,369. Nevertheless, owing to the saving in the cost of fuel resulting from the Diesel engine installed in 1913 coming into full use during the year, and in spite of the increased cost of coal and the increase in local rates, the balance carried to net revenue account was £249 higher than for 1913, namely, £8,813. The net revenue account, after payment of debenture interest, trustees' fees, and premium on sinking fund policy, showed a balance of £4,787, which represented the net profit, as against £4,643 for 1913. This amount the corporation had utilised by paying a dividend of 6 per cent. on its ordinary shares, and by transferring the balance of £1,019 to depreciation reserve fund account. It was difficult to give any accurate forecast for 1915. Up to the present the revenue from the Chiswick undertaking continued to show a considerable falling off, owing to the lighting restrictions now in force. This falling off, however, would naturally be proportionately less during the summer months. To make up to a certain extent for the loss of revenue, the advance in the price of coal and other increases in the cost of production, the directors of the corporation, in common with other Metropolitan supply companies, were reluctantly compelled to increase the charge for current by 10 per cent. from April 1st. As regarded Aberystwyth, conditions were looking better, as the revenue had increased owing to the town being full of soldiers who were billeted at the various boarding-houses, etc., which had consequently used more current than usual at the non-season period. The corporation were installing a second Diesel engine at Aberystwyth in place of the old steam set, and estimated that a considerable saving in the cost of production would be effected by this expenditure.

Mr. W. B. Esson seconded the motion.

In reply to Mr. Charrington, Mr. Esson said the extra Diesel engine to be installed at Aberystwyth would bring the capacity up to 350 kw. They were replacing a steam set, and it did not increase the capacity, but the economy.

Delhi Electric Tramways and Lighting Co., Ltd.

Mr. A. W. Tait presided at the annual meeting, held on May 19th, at Basildon House, E.C. He said that the combined undertakings showed a net revenue of £8,163, as compared with £6,252 in 1913, and £2,990 in 1912. The progress was satisfactory. The increase in the gross revenue had been 10 per cent. for the tramways and 19 per cent. for the electricity supply. The tramway traffic receipts had been adversely affected by the monetary conditions created by the war, and, in addition to the usual accident claims, they had to meet a judgment for a somewhat costly accident claim. But for these incidents, the tramway undertaking would probably have paid its way during the year, and this after charging current from the supply undertaking at the rate of 1¼d. per unit. The unsuitable type of car was responsible for heavy annual maintenance charges and abnormal current consumption, but they were unable to deal with that matter until capital could be provided to install new cars with double motor equipment. Permanent-way maintenance was still heavy, but contract arrangements made during the year had resulted in a small saving. The passengers carried numbered 5,465,450, an increase of 13¼ per cent. Over 57 per cent. of the passengers only travelled half-a-mile or under, and the first-class traffic still remained very small, being under 6 per cent. of the total. The total number of car miles run was 434,094, an increase of 9 per cent., while the receipts per car mile were 5.4d., as against 5.2d. in the previous year, and they carried the total available population 23¼ times during the year, as against 20¾ times in 1913. During the year they had some difficulty with the staff, and in May they had a serious strike, in which they lost nearly half of the drivers. With a view to encouraging a better class of employé, they had had under consideration provident and bonus schemes. A bonus scheme had been put into operation, the effect of which would be closely watched, and if the results justified it, a provident scheme might also be instituted. With regard to the electricity supply undertaking, he was pleased to say that there had been no serious failure of any kind in the power station during the year In order to cope with peak loads, and to supply further stand-by in case of breakdown on either of the oil engines or of the steam plant, satisfactory arrangements had been made whereby their power station was to

be linked up with the Government station, which would enable them when desired to draw alternating current from them, and, should it be necessary, to give them a supply when the same might be available. The units generated showed an increase of 26 per cent., and the average cost was .92d., as compared with 1.08d. The units sold for lighting and power were 931,219, an increase of 26 per cent., and the units used by the tramway system were 572,393, an increase of 16 per cent. The units sold for lighting and power in 1909 were 188,072, as against the 931,219 last year—an increase of 395 per cent. in the five years; while the traction units during the same period showed an increase of 55 per cent. During the first six months of last year they connected 193 new consumers, which was the highest rate the company had reached, but during the second six months they only connected 138 new consumers. The growth of the power supply had been quite satisfactory, but they could not expect any great developments in this connection, as Delhi was not a large industrial centre. There might be some falling off in the rate of progress during the present year owing to the causes he had referred to, and to a certain amount of competition which had sprung up. With regard to the current year, he could only say that, provided they had no breakdowns in the power station, or serious diminution in revenue due to the conditions created by the war, it was reasonable to suppose that the results would show some improvement over those for 1914. With regard to the new city of Delhi and the concession for electric lighting and tramways, nothing would be done in regard to this until the shareholders had had an opportunity of expressing their opinion on the whole matter. The directors would shortly have an opportunity of discussing the situation with the general manager, who proposed to come to London. His (the Chairman's) impression was that the Government would not take any definite steps towards asking for tenders for some little time. There was, however, considerable field for expansion of the company's existing system of supply, and during the next twelve months they would have to incur capital expenditure to approximately £25,000 in order to cope with the demand. Before the war the directors had under consideration an issue of second debentures, to which the consent of the Indian Government had been obtained. If conditions improved, he hoped before very long they might be able to do something in the way of raising the necessary capital, but that, of course, was dependent upon the sanction of the Treasury during the period of the war, and application was being made to ascertain whether permission would be granted. Although it was unfortunate that the surplus profits must be applied in the manner he had indicated, there was at least some satisfaction to the shareholders in knowing that steady progress was being made, and that the balance of profits which would otherwise be available for dividend on the preference shares continued to grow, and he hoped that at some time in the not very distant future they might be able to declare a preference dividend.

Mr. T. W. Stratford-Andrews seconded the motion, which was adopted.

River Plate Electricity Co., Ltd.

The annual general meeting was held on Friday last, at Capel House, New Broad Street, E.C. Mr. M. W. Mattinson, K.C., who presided, said that the accounts showed a substantial reduction in the available profits compared with 1913. The company had been in existence 12 years, and at the end of every year up to the present he had been able to report an improvement in its position. On this occasion they had to submit to some set-back in their progress, but when all the circumstances of the times were taken into account the result was only what they might reasonably have expected. The net profits were about £10,400 less, and half of that deficiency was solely and directly attributable to the war, as during the past year the company had only received three months' instead of a full twelve months' interest upon its investment in the German Trans-Oceanic Electric Co., of Berlin. The acquisition of that investment went back to the inception of the company, when they disposed of the old and decayed electric station at Buenos Ayres to the German company, which then, as now, was the principal electric company in that city. In return, in addition to some cash, they received £150,000 in 5 per cent. obligations of the company, which had always paid large dividends on its ordinary shares, which came behind their obligations. The annual amortisation of the obligations and the interest had been met up till last year, when the outbreak of war suspended all commercial relations between this company and Germany. They assumed that at the conclusion of hostilities the German company would resume payment of its obligations. The shortage of income last year from that default was a little over £5,000, but as they received one quarter's interest on the bonds, the shortage in the current year would be some £1,700 more. The balance of the lessened profit was due to less favourable working results in the Argentine, due largely, though not wholly, to the war. While the number of their consumers at La Plata had increased substantially, the average consumption of current had gone down. Since the war broke out they had had to contend with a rise in the price of materials, and the profit they made out of the public lighting had been cut into by the rise in the price of carbons. The question of fuel had given, and still continued to give, the board considerable concern, and but for the care and thrift exercised by the manager (Mr. Lindop) the diminution in profits would have been much greater than it was. They were carrying out their engagements with the Government both in the letter and the spirit by putting the lines underground in most of the important thoroughfares. They had also agreed to substitute half-watt lamps for the public lighting in place of the present arc lamps. The plant which had thus become obsolete had been scrapped, the loss being charged against revenue. Taking all those considerations into account, he thought it was cause for satisfaction that the profits were as large as they were. The sale of the company's Tucuman station was completed last June, and the board were satisfied that they had acted wisely in disposing of it upon the terms which they obtained. The whole district had been in a most depressed condition throughout the year, and if they had continued to operate the station under the competitive conditions which had prevailed they must have had a large loss, which would have helped to materially reduce their profits at La Plata. After careful consideration the board had decided to recommend the payment of a dividend of 8 per cent. for the year upon the ordinary stock. That was less than they had paid during the previous four years, but it was in excess of the average dividend paid since the incorporation of the company. In determining the dividend they had to have regard to the future outlook, and he estimated that by carefully husbanding their resources they would be able to complete their programme without having to raise any fresh capital or creating any floating debt. They felt that they could easily pay the 8 per cent. ordinary dividend without unduly straining their resources, and the reason they were able to do that was because they had kept the ordinary capital down to a very low figure. They had built up the business out of the savings of former years and out of profits made in other directions, and by the issue of ordinary shares at a premium. In the first four years of their existence they paid no ordinary dividend; in the fifth year they paid 2½ per cent.; the next year 6 per cent., while during the four years preceding 1914 they paid 10 per cent. This year they had had to drop to 8 per cent., which gave an average of 6 per cent. over the whole period. He might say that although they were not putting anything this year to general reserve, they were strengthening the future position by carrying forward £20,000 instead of £13,000 as last year.

Mr. R. Miller seconded the motion, which was carried unanimously.

Willans & Robinson, Ltd.

The annual meeting was held recently at the Victoria Engineering Works, Rugby. Mr. J. C. Peache, who presided, said that the accounts showed a substantial improvement in revenue, notwithstanding the abnormal times. After paying the dividend as recommended, the reserve fund would amount to more than sufficient to cover a year's dividend on the preference shares and stock. For the first six months of the year 1914 conditions were normal, and they obtained a fair share of turbine business at prices somewhat better, owing to the excessive competition of recent years, than had previously prevailed. In consequence, the profit from this, which was the main portion of their business, had been the principal factor in the improved results shown. The Diesel engine, too, had continued to provide a satisfactory volume of trade, and the repeat orders which were being regularly placed by customers bore practical testimony to the reliability and excellence of the Willans-Diesel engine. With the outbreak of war the whole conditions of business were disturbed. From November onwards their standard lines of output had to take a second place, and the volume of production, too, was gravely affected, for the directors considered it right not only to give absolute preference to Government work, but also to encourage enlistment among the employés. Over 20 per cent. of the male employés of the company were now serving in His Majesty's Forces—that was some 50 per cent. of the male employés who were eligible. Since November the works had been largely engaged on the supply of munitions of war, and the ordinary business had suffered not only by being to a considerable extent put on one side to make way for Government work, but also by increased cost of production due to the general rises in wages and materials which had taken place and to the difficulty in temporarily replacing the men who had gone to the Front. Liberal provision was being made by the company for dependents of these men while away on service, and it was intended to reinstate them on their return. The heavy increase of work that had been thrown on the remainder of the staff by the absence of a large proportion at the Front had been cheerfully and willingly borne; and the workpeople (which included a large contingent from Belgium) in all branches of the business had been keeping good time and maintaining a high standard of quick and efficient production. The company's managing director had recently been appointed chairman of the British Electrical and Allied Manufacturers' Association, an important institution that had a far-reaching influence on the interests of both employers and employed in the particular branches of industry in which the company was chiefly concerned. The appointment was, too, a well-deserved recognition of the merits of the managing director.

Mr. Davenport seconded the resolution, which was carried.

Brisbane Electric Tramways Investment Co., Ltd.

The annual meeting was held on Wednesday at Winchester House, E.C. Mr. H. R. Beeton, in proposing the adoption of the report, said that the total receipts of the tramways for the past year amounted to £348,406, as compared with £316,244 for 1913, and the expenditure, including costs in connection with the Arbitration Court award, amounted to £194,960, as against £191,936. The profit, therefore, amounted to £153,446, as against £124,308, and that, with £3,436 brought forward, gave an available balance of £156,882. This is to be dealt with as shown in our last issue. There had been an increase of £150,000 in the ordinary share capital, due to the issue of 30,000 new shares, which were all taken up by the shareholders. The capital expenditure on the tramways during the year had amounted to £103,751 for the construction of extensions, the purchase of equipment and plant, the building of new car sheds, and the acquisition of a new power house site. The site of their present power house station was held on a lease from the Queensland Railway Commissioners which expired in 1926, but which might be required by the Government before that date. They had therefore thought it prudent to avail themselves of an excellent site which was available not far from the present station, so that the alteration to the feeder system would be reduced to a minimum. £47,500 of available cash not immediately required had been invested in the purchase of £50,000 of the War Loan, a course which he felt sure the shareholders would approve. The most important event during the year had been the High Court's decision in the tramway case which, as they anticipated, annulled the decision of the Commonwealth Conciliation and Arbitration Board. A number of men had joined the Australian Expeditionary Force, and their employés were contributing to the patriotic fund at the rate of £100 per month. The company would, of course, keep open the places of the men who were serving with the Colours. The Tramway Company had already subscribed to the British war funds, and they proposed to extend their support to the Queensland war funds.

Mr. J. B. Concanon seconded the resolution.

Replying to a shareholder, the Chairman said that the power station and the road equipment were maintained in the highest state of efficiency. They were undoubtedly approaching the time when they would have to face a certain limited expenditure on the renewal of the permanent way, for which their present renewals fund was altogether adequate. The reserve fund was available for the general purposes of the company, either for the equalisation of dividends or for periodical distribution by way of bonuses should the board consider it prudent.

The report was adopted.

STOCKS AND SHARES.

Tuesday Evening.

Italy's long-delayed intervention in the war has had a cheering effect upon Stock Exchange sentiment, but, so far, has been without influence on quotations. The idea is prevalent that, with the help of our latest ally, the war should be shortened by at least six months; and her entry into the theatre of hostilities—as the newspapers put it—has been hailed with satisfaction in the Stock Exchange, as elsewhere. The most dramatic event of the week just past was the denunciation of "a certain section of the English Press" which attacked Lord Kitchener on the day before the Stock Exchange separated for its Whitsun holiday, and which culminated in a vote of confidence in the War Minister, followed by the burning of the *Daily Mail*. Lord Kitchener replied in a cordial telegram of thanks.

Home Railway securities remain dull, and the terrible tragedy of the troop train lies like a pall over the market. Where prices have moved at all, they have gone back a little, the Undergrounds easing off with the rest. The succession of Lord George Hamilton to the chairmanship of the Underground Electric Railways of London, in place of Sir Edgar Speyer, Bart., P.C., caused no alteration in prices. Central Londons are still wanted, but Metropolitans and Districts have both gone back ¼. Other stocks are dullish.

Electricity Supply issues show one alteration—a fall of ¼ in County of London Preference being the solitary instance of a change in this market for a fortnight. It is by no means easy to pick up shares. There are buyers about for several of the best-known issues, which, however, are not offered at anything like the market prices. It might be supposed from the quietude of the market that the tone was depressed, but, in point of fact, the difficulty is to get shares, not to sell them. This, of course, is the season of the year in which the public investor as a rule declines to have anything to do with what may be called illumination issues. In these disjointed times, however, there seems to be nothing surprising in the demand for electric lighting shares, with an accompanying absence of supply.

Most of the markets connected with Mexican securities have been further depressed, the reason being lurid illumination cast upon the affairs of that country by a circular issued to the proprietors of the Mexico Tramways Company and its three associated concerns. In this it is pointed out that affairs are in a state of chaos, and practically all business is at a standstill. Matters have reached a climax, and the control of the tramways has been taken out of the hands of the directors and officials. The rate of exchange is 5d. to the peso, instead of the normal 25d., and a further drop may be expected. The Mexico Tramways employés asked last October for 25 per cent. increase of wages, recognition of the Union, and other conditions, to agree to which would have ruined the Company. A strike was proclaimed, and the tramways ceased running. Then the authorities took over the operation of the lines, doubled the salaries of part of the staff, and gave a 25 per cent. rise to the rest. The tramways receipts were paid into the company's bankers for a short time, but later on were diverted into the Government Treasury. When Carranza's representative was driven from the City of Mexico by Zapata, he took with him the "controllers" off the cars, with the result that all traffic has ceased.

The Mexican Light and Power Company has suffered little physical damage, but although electric light is still freely used, it has not been possible to obtain payment for the same. Over two million pesos is owing for street lighting or power furnished to the Government. Repeated protests have been filed by the board through different diplomatic representatives, but apparently without any success. The board feel that the future of the enterprises must necessarily depend upon the development of the political situation in Mexico, and the future attitude of the United States Government towards that country.

Other foreign securities are none too good. Brazil Tractions have fallen a further 2 points to 52, the Rio rate of exchange being erratic and unstable. Dr. F. S. Pearson (the president of the company), who went down with the ill-fated *Lusitania*, has been succeeded by Mr. Alexander Mackenzie, of the Rio Tramways and San Paulo Light and Power Companies. Anglo-Argentine Trams have weakened on the passing of the dividend on the Ordinary shares. For the past half-decade, 1909-13, the annual dividends have been 6, 7¼, 7¾, 8¼ and 6¾ per cent. respectively. The net revenue fell off by only £26,000, but the interest charges were largely increased; and instead of paying a dividend on the Ordinary shares, the directors have elected to carry forward £96,400, an increase of £83,000 as compared with the previous year. In view of the very large amount of British capital invested in the Anglo-Argentine Tramways, it may be of interest to set out the principal items in the balance-sheet for the past seven years; the figures compare as follows:—

Liabilities.

	Debentures.	Pref. capital.	Ordinary.	Sinking fund.	Reserve.	Paving fund.	Renewal fund.
1908 ..	£831,600	£4,400,025	£1,500,000	£24,395	£63 777	£25,692	£312,900
1909 ..	6,305,540	5,700,000	2,500,000	51,706	66 014	25,701	187,611
1910 ..	7,785,484	5,700,000	2,500,000	79,820	66,014	41,675	179,546
1911 ..	8,785,154	5,700,000	2,500,000	38,637	66,014	44,315	177,398
1912 ..	10,005,732	5,700,000	2,500,000	42,432	66,014	43,876	169,371
1913 ..	10,715,961	5,700,000	3,005,760	46,380	75,145	44,189	171,467
1914 ..	12,191,836	5,700,000	3,250,000	52,144	75,145	48,232	183,887

Assets.

	Concessions and property.	Discounts on debs.	Stores.	D'btors.	Investments at cost.	Cash and bills.	Total assets.
1908 ..	£6,458,739	£74,862	£83,593	£26,106	£305,786	£48,092	£7,365,839
1909 ..	13,914,493	661,769	161,263	36,156	317,991	84,522	15,316,805
1910 ..	14,634,036	772,312	185,303	113.581	317,901	667,766	16,761,100
1911 ..	15,757,347	778,879	401,885	149,462	316 591	756,207	18,185,963
1912 ..	17,081,646	814,174	405,272	144,213	316,279	495,639	19 281,203
1913 ..	18,554.215	781,397	430 656	120,033	339,005	244,593	20,474,132
1914 ..	19,510,500	869,018	301,468	66,989	536,107	742,300	22,094,660

The Bombay Electric Supply and Tramways Company has just announced a dividend on the ordinary shares at the rate of 6 per cent., which is the same as that for a year ago; a bargain was done on Tuesday at $7\frac{9}{16}$, being the first transaction recorded in the shares since the Stock Exchange re-opened, at the beginning of January. The Shanghai Electric Construction Company has announced a dividend of 6 per cent. for the year, a decrease of 1 per cent. as compared with 1913; the falling-away is explained entirely by the loss of exchange on subsidiary coinage, which came to no less than £28,000, equal to 8¾ per cent. on the capital of the Company.

The Telegraph market is irregular. Eastern Ordinary and Preference are both better, but Globes of each sort have given way a little. Anglo-American Preferred fell a point, and New York Telephone 4½ per cent. bonds are 1½ lower. The United River Plate Telephone report is a good one, showing a net profit of £161,800, allowing payment of the regular 8 per cent. for the year, free of income-tax. The report of the Cuban Telephone Company explains that the general financial stringency has made impracticable the further placing of securities; hence the action of the directors in not declaring the dividends which have been earned. For the year, the Preferred stock received six months' dividend, and there was one distribution for three months made on the Common. The company's 5 per cent. first mortgage bonds stand about 79, but the Preferred has not changed hands this year.

In the manufacturing group, Callenders gained the fraction at 12½, though, on the other hand, Henleys eased off to 14 and India-Rubber shares to 11, while British Insulated at 11¼ are ¼ down on the week. British Aluminiums have hardened, and manufacturing shares on the whole are very steady, commanding a fair amount of attention. The rubber market keeps firm, owing to the produce holding its price of 2s. 5d. per lb.; while nearly every report which appears shows substantial reduction in working costs. The Armament issues have a slightly sagging tendency, for which absence of business is held responsible. The strong measures taken by the L.C.C. in connection with the strike of tramwaymen had no effect upon prices in the market, but they have been discussed with considerable satisfaction. In the Stock Exchange, at all events, there is extremely scant sympathy for the employés who chose a time like the present to disregard the counsels of their leaders and to do their best to add discomfort and loss to the community at large.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price May 25, 1915.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.				
Brompton Ordinary	10	8½	—	£6 1 8
do. 7 per cent. Pref.	7	7½	—	4 10 4
Charing Cross Ordinary	5	4½	—	5 11 1
do. do. do. 4½ Pref.	4½	4⅝	—	5 9 1
do. do. City Pref.	4½	4	—	5 12 6
do. 4 Deb.	4	90	—	4 9 0
Chelsea	5	4⅝	—	5 8 1
do. 4½ Deb.	4½	92	—	4 17 10
City of London	9	14½	—	6 6 4
do. do. 6 per cent. Pref.	6	12½	—	4 18 0
do. do. 5 Deb.	5	112	—	4 9 3
do. do. 4½ Deb.	4½	96	—	4 11 10
County of London	7	11½	—	6 1 9
do. do. 6 per cent. Pref.	6	11½	— ⅛	5 4 4
do. do. 1st Deb.	4½	100	—	4 10 0
do. do. 2nd Deb.	4½	95 xd	—	4 14 9
Kensington Ordinary	9	7	—	6 8 7
London Electric	4	12	—	6 18 0
do. do. 6 per cent. Pref.	6	5	—	6 0 0
do. do. 4 Deb.	4	87	—	4 12 0
Metropolitan	8½	8½	—	5 12 5
do. 4½ per cent. Pref.	4½	4	—	5 12 6
do. 4½ Deb.	4½	94	—	4 15 9
do. 3½ Deb.	3½	75	—	4 13 4
St. James' and Pall Mall	10	8	—	6 5 0
do. do. do. 7 per cent. Pref.	7	6⅞	—	5 9 10
do. do. do. 3½ Deb.	3½	75	—	4 13 4
South London	5	3	—	6 18 4
South Metropolitan Pref.	7	1⅜	—	6 4 5
Westminster Ordinary	9	7½	—	6 0 0
do. 4½ Pref.	4½	4⅛	—	4 12 4
TELEGRAPHS AND TELEPHONES.				
Anglo-Am. Tel. Pref.	6	105½	−1	5 13 8
do. Def.	1½	22⅜	—	6 14 10
Chile Telephone	8	6½	—	5 18 5
Cuba Sub. Ord.	5	8½	—	5 17 8
do. Pref.	10	15	— ⅛	6 13 4
Eastern Extension	7	13½	—	*5 17 5
do. 4 Deb.	4	92	—	4 7 0
Eastern Tel. Ord.	7	134	+2	*6 0 0
do. 3½ Pref.	3½	74	+ ⅛	4 15 3
do. 4 Deb.	4	92	−1	4 7 0
Globe Tel. and T. Ord.	6	11	— ¼	*6 4 9
do. Pref.	6	11⅞	— ⅛	5 1 0
Gt. Northern Tel.	22	30	—	7 6 8
Indo-European	65/-	54	—	6 0 4
Marconi	20	11⅛	—	11 17 0
New York Tel. 4½	4½	96⅜	−1¼	4 13 0
Oriental Telephone Ord.	10	2	—	5 0 0
do. Pref.	6	1⅞	—	5 1 1
Tel. Egypt Deb.	4½	88	—	5 2 3
United R. Plate Tel.	8	6⅜	—	*7 0 8
do. Pref.	5	5	—	5 0 0
West India and Pan.	1	1	—	7 11 0
Western Telegraph	7	13⅜	—	*5 16 5
do. 4 Deb.	4	91	—	4 6 6
HOME RAILS.				
Central London, Ord. Assented	4	80	+1	5 0 0
Metropolitan	1½	28⅜	— ¼	4 7 2
do. District	Nil	16¼	— ¼	Nil
Underground Electric Ordinary	Nil	1⅜	—	Nil
do. do. "A"	Nil	5/6	—	Nil
do. do. Income	6	78⅛	— ¼	*8 15 0
FOREIGN TRAMS, &c.				
Anglo-Arg. Trams, First Pref.	5½	4½	— ⅛	6 9 5
do. 2nd Pref.	5½	3⅝	— ¼	7 6 8
do. 4 Deb.	4	81½	+ ½	4 18 3
do. 4½ Deb.	4½	88	—	5 2 8
do. 5 Deb.	5	90	—	5 11 1
Brazil Tractions	6	52	−2	11 10 10
Bombay Electric Pref.	6	10⅜	—	5 16 10
do. 4½ Deb.	4½	91	—	4 19 0
Mexico Trams	Nil	35	−5	Nil
do. 5 per cent. Bonds	—	53	−3	Nil
do. 6 per cent. Bonds	—	35	−2	Nil
Mexican Light Common	Nil	20	—	Nil
do. Pref.	Nil	39	−2	Nil
do. 1st Bonds	—	49	−2	—
Adelaide Sup. 6 per cent. Pref.	6	5⅝	—	5 13 0
do. 5 Deb.	5	108	—	4 17 1
MANUFACTURING COMPANIES.				
Babcock & Wilcox	14	51/-	—	5 9 8
British Aluminium Ord.	5	21/-	+6d.	4 15 3
do. Pref.	6	18/6	—	6 9 9
British Insulated Ord.	15	11½	— ½	6 13 4
do. Pref.	6	6⅜	—	5 0 0
British Westinghouse Pref.	7½	1⅛	—	7 15 0
do. 4 Deb.	4	72	—	5 11 1
do. 6 p. lien	6	101	+2	5 19 0
Callenders	15	12½	+ ½	6 0 0
do. 5 Pref.	5	5	—	5 0 0
do. 4½ Deb.	4½	98	—	4 12 4
Cartner-Kellner	15	8½	—	4 12 6
Edison & Swan, £8 pd.	Nil	12/0	—	Nil
do. do. fully paid	Nil	1⅞	—	Nil
do. do. 4 Deb.	4	63	—	6 7 0
do. do. 5 % Deb.	5	60	—	8 6 8
Electric Construction	6	14/-	—	8 11 6
do. do. Pref.	7	1⅛	—	6 11 9
Gen. Elec. Pref.	6	10⅝	—	5 17 8
Hewlett's	20	14½	— ½	*7 0 4
do. 4½ Pref.	4½	4⅛	—	4 12 4
do. 4½ Deb.	4½	97	—	4 11 9
India-Rubber	5	9	— ⅛	5 11 1
Telegraph Con.	20	87	—	6 9 10

* Allowance made for dividends being paid free of income-tax.

Swedish Electrical Exports.—The exports of electrical machinery and apparatus from Sweden during the three months ending with March last attained a value of £66,140, as compared with only £55,402 in the corresponding quarter of 1914. On the other hand, there was a marked decline in the exports of telephone material and apparatus—from £102,781 to £61,977.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, May 26th.

CHEMICALS, &c.	Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric per cwt.	4/6	..
a „ Nitric „	19/-	..
a „ Oxalic per lb.	..	..
a „ Sulphuric per cwt.	..	..
a Ammoniac Sal „	£49	..
a Ammonia, Muriate (large crystal) per ton	£40	..
a Bleaching powder „	£9	..
a Bisulphide of Carbon „	£21	..
a Borax „	£22	..
a Copper Sulphate „	£29	..
a Lead, Nitrate „	£35	..
a „ White Sugar „	..	..
a „ Peroxide „	..	..
a Methylated Spirit per gal.	7d.	..
a Potassium, Bichromate, in casks per lb.	..	..
a Potash, Caustic (88/90 %) per ton	1/6	..
a „ Chlorate per lb.	1/6	..
a „ Perchlorate „	Nom.	..
a Potassium, Cyanide (98/100 %) „ (for mining purposes only)	6½/-	..
a Shellac per cwt.	..	..
a Sulphate of Magnesia per ton	£11 10	..
a Sulphur, Sublimed Flowers „	£8	..
a „ Recovered „	£8 10	..
a „ Lump „	£10 2 6	..
a Soda, Caustic (white 70/72 %) „	10½d.	..
a „ Chlorate per lb.	45/-	..
a „ Crystals per ton	8½d.	..
a Sodium Bichromate, casks per lb.		
METALS, &c.		
b Aluminium Ingots, in ton lots per ton	£95	£5 inc.
b „ Wire, in ton lots (1 to 14 S.W.G.) „	£195	£5 inc.
b „ Sheet, in ton lots „	£195	£5 inc.
p Babbitt's metal ingots „	£30 to £221	..
c Brass (rolled metal 2" to 12" basis) per lb.	1/- to 1/0½	..
c „ „ (solid drawn) „	1/0½ to 1/0⅝	..
c „ Wire, basis „	1/0½ to 1/0⅝	..
c Copper Tubes (solid drawn) „	1/1½ to 1/1⅝	..
g „ Bars (best selected) per ton	£100	..
g „ Sheet „	£100	..
g „ Rod „	£100	..
d „ (Electrolytic) Bars „	£89	..
d „ „ Sheets „	£107	..
d „ „ Rods „	£95	..
d „ „ H.C. Wire per lb.	11¼d.	..
f Ebonite Rod „	8/-	..
f „ Sheet „	2/6	..
a German Silver Wire „	1/9	..
h Gutta-percha, fine „	6/10	½d. inc.
h India-rubber, Para fine „	2/7½	11d. inc.
f Iron Pig (Cleveland warrants) per ton	65/6	..
l „ Wire, galv. No. 8, P.O. qual. „	£20	5/- dec.
g Lead, English Pig „	£20 15	..
m Manganin Wire No. 28 per lb.	..	..
g Mercury per bot.	£11 15 to £12	..
c Mica (in original cases) small per lb.	4d. to 2/6	..
e „ „ „ medium „	3/- to 5/-	..
e „ „ „ large „	6/6 to 10/6 & up.	..
o Nickel, sheet, wire, &c. „	Nom.	..
p Phosphor Bronze, plain castings „	1/1 to 1/3½	..
p „ „ rolled bars & rods „	1/2 to 1/8½	..
p „ „ rolled strip & sheet „	1/3½ to 1/6½	..
o Platinum per oz.	185/-	..
d Silicium Bronze Wire per lb.	1/1	..
r Steel, Magnet, in bars per ton	£80	£10 inc.
g Tin, Block (English) „	£164	£2 dec.
n „ Wire, Nos. 1 to 16 per lb.	2/8	..
p White Anti-friction Metals per ton	£52 to £194	..
k Zinc, Sh't (Vieille Montagne bnd.) „	Nom.	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

The Chief Technical Assistants' Association.—An inaugural dinner in connection with this Association was held at Pinoli's Restaurant, Wardour Street, W., on Thursday evening, May 20th, with Mr. J. T. Baron (resident engineer of St. Pancras) in the chair, supported by Mr. T. K. Richardson (generating engineer of St. Marylebone) in the vice-chair. This Association, which was originally formed by the chief assistants of London, embodies generally the chief technical assistants of the large undertakings. As a consequence of the war, it was not thought expedient that any musical programme should be arranged, and the proceedings consequently partook largely of a speech-making character; amongst the gentlemen who spoke in support of the Association and its objects were the following:—The chairman and vice-chairman; Mr. J. R. J. Bowden (deputy engineer of Hackney); Mr. J. Leadbeater (assistant engineer at Hampstead); Mr. J. H. Parker (chief assistant engineer at Croydon); Mr. H. F. J. Thompson (chief assistant engineer at Battersea); and Mr. W. Young (resident engineer at Stepney). On the whole, a very enjoyable evening was spent, and the chief object for which the dinner was held, namely, that the more recent members might have an opportunity of making the personal acquaintance of, and becoming better known to, the older ones, was thoroughly realised.

A MOTOR SEARCHLIGHT PLANT.

One of the features of the great war that will stand out prominently when its full history comes to be written will be the many new uses it has found for the motor vehicle. Among these, from an electrical point of view, are the motor

Searchlight Mounted on Special Trolley.

X-ray machines for use in conjunction with the medical service, automobile wireless telegraph stations, and travelling searchlight plants. Shortly after the outbreak of hostilities, we published some particulars and illustrations of the motor searchlight plants which had been constructed by Messrs. De Dion, Bouton & Co. for the French War Office, and we are now able to do the same as regards a motor searchlight plant which has recently been completed by the Austin Motor Co., Ltd., of Northfield, Birmingham.

The motor lorry, on which the searchlight outfit is carried, consists of a standard Austin 2-3-ton chassis, the bodywork having been specially designed and constructed for the purpose for which the vehicle is being used. The electricity-generating plant, which has also been designed and manufactured by the Austin Co., is located in the forward part of the body, behind the driver's seat, and is entirely distinct from the engine employed to propel the vehicle; it comprises an Austin 12-h.p. 2-cylinder petrol engine provided with a specially-designed cooling system and exhaust-silencing chamber. The engine is coupled direct to a dynamo having an output of 120 amperes at 80 volts, and at a speed of 1,000 r.p.m.; the generator is connected up to a drum carrying a long length of cable, the contact being so arranged as to avoid the possibility of a fault developing from it whilst the drum is in motion.

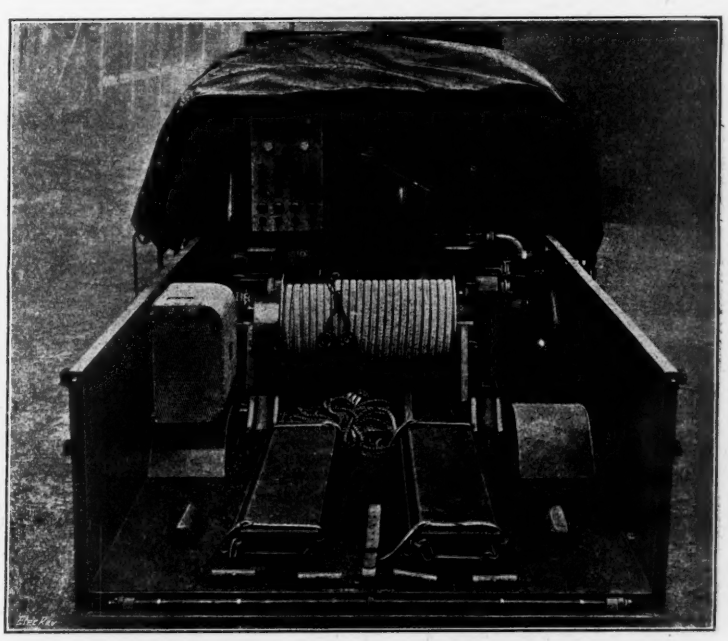
In order to allow the searchlight to be used some distance away from its current-generating plant, the projector, as will be seen, is carried on its own special trolley, which runs on four pneumatic-tired wheels.

In order to provide a safeguard against the danger when on inclines of the trolley over-running the men, the rear wheels are provided with brakes operated by a hand lever at the back of the trolley chassis. The projector itself was constructed by Messrs. Crompton & Co., Ltd., of Chelmsford, and is mounted on a swivelling base, and also swings in horizontal trunnions. It will also be noted that a seat which revolves with the projector is provided for the operator.

Both the horizontal and vertical movements are controlled by means of worm gearing; the latter can be thrown out of gear, enabling the light to be quickly swung into the desired position, and the beam adjusted with the necessary precision. Although the projector illustrated is only of 24 in. diameter, the plant is adequate to furnish the current for a 30-in. one, but by the use of the smaller diameter a highly efficient result is assured.

The searchlight trolley, which is unloaded from, and re-loaded on to, the motor lorry by means of ramps and tackle, has been specially constructed to enable it to be used over rough ground—possibly for long distances—independently of the motor-lorry, in the event of capture, damage to, or destruction of that unit.

The electricity generating plant, when not required to run the searchlight, can be used to furnish current for the temporary lighting of officers' quarters, field hospitals, or any other purpose for which a good light is desirable, a switchboard being included in the equipment.



Searchlight Generator, Cable Drum, &c., on Motor Lorry.

SINGLE AND MULTIPLE GROUND-WIRE ANTENNÆ.

The capital cost and various working risks associated with the use of ordinary aerials offer sufficient incentive to investigate thoroughly the possibilities of low horizontal aerials. If found reasonably effective, the latter should be useful in many commercial stations, and offer obvious advantages for special temporary Press installations and for military purposes, where easy erection and inconspicuousness are important considerations. For some time there has been no doubt that bare wires laid along dry soil are capable of receiving radio-signals more or less effectively, but only recently have the results of important American experiments been published, showing that such a conductor remains effective even on damp ground, and can easily be modified to secure efficiency of reception *commensurable with that of an elevated aerial over commercial distances*. The tests in question have been in progress at Beloit (Illinois) for

some 18 months past, and have led to certain definite conclusions, although further quantitative data are required before the design of horizontal aerials can be reduced to an exact basis.

Since orientation affects considerably the working of horizontal antennæ, it is necessary to bear in mind the relative positions of the stations mentioned below; these are shown in fig. 1.* Most of the tests were carried out between Beloit and a field station at Freeport, the receiving circuit there being as shown in fig. 2, and using crystal detectors. Signals of uniform intensity were emitted from Beloit of 900-m. wave length, and of the bare No. 18 copper wire (274 m. long) at Freeport, half C D rested on the earth while A B, at first, was hung by linen thread 7 ft. above ground. As a result of preliminary tests it was found best to shorten the wire A B (towards Beloit) and lay the whole wire C X on the ground, the best lengths of wire to receive the 900-m. waves over a distance of 34 miles being C D = 188 m. and A X = 61 m. During most of the tests the grass-covered thin soil, with limestone subsoil, was dry, but with the wires lying in wet grass the Beloit clock signals could still be heard, and no difference could be detected between the efficiency of the system when C D rested on wet soil in a field of stubble and when it was insulated on

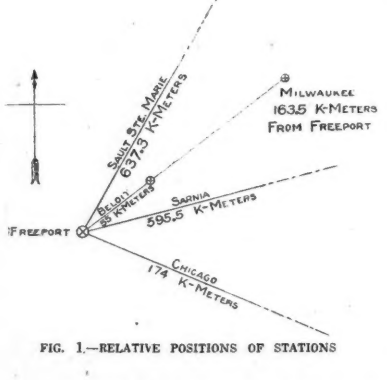


FIG. 1.—RELATIVE POSITIONS OF STATIONS

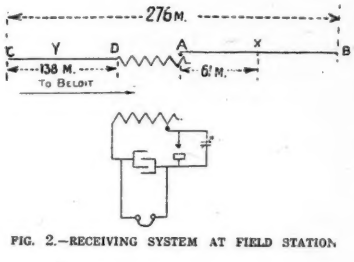


FIG. 2.—RECEIVING SYSTEM AT FIELD STATION.

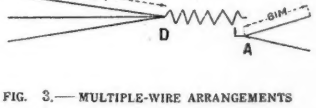


FIG. 3.—MULTIPLE-WIRE ARRANGEMENTS

stakes 1 ft. high. No appreciable improvement in tuning or loudness was secured by substituting for C D a connection to the water of a creek.

With the wire A X due north and the longer wire C D in various positions, best reception was obtained with the long wire extending directly away from Beloit. Commercially readable signals could be obtained using only ¼ KW. input to the Beloit aerial (four 90-m. horizontal wires, two 30-m. slanting wires; horizontal section at 45° to the meridian, free end extending S.E.; logarithmic decrement 0·16 with 900-m. wave.)

By using a "fan" of three wires in parallel to the left of D (fig. 3) and of two wires to the right of A, the intensity of signals was greatly increased, and the received intensity of Milwaukee and Chicago signals seemed to be as great as when the large elevated aerial at Beloit was used. By adding a third 61-m. wire (to form a 3-wire fan) at A, still better results were obtained, Sault Ste. Marie and Sarnia signals being easily read. A further important advantage of the multiple over the single-wire arrangement is that tuning is as sharp as with commercial aerials of the elevated type.

If these results can be quantitatively confirmed and established for all ordinary conditions of soil and atmosphere, their importance can hardly be exaggerated, for it means that a symmetrical multiple earth-wire system having pronounced directive effect can be used for receiving in practical radio-communication *without using greater sending power than for elevated aerials*. Further tests appear to be desirable on very wet soil, for notwithstanding the fact that bare wires were used in these tests, the soil surface was mostly dry, and when the outer ends of the wires were deliberately connected to earth, the system would not respond to incident radiation. From the work already done, it seems that an earth-wire system operates best when its electrical length (including transformer primary) is about one-fourth the incident wave length. The receiving instruments should be inserted about one-third the distance from the end nearest the transmitting station, and to operate at the same efficiency, the total length of the ground-wire system should be about twice that of an elevated aerial.

* C. A Culver and J. A. Riner. *Electrical World*, 1915, p. 723.

ELECTRIC POWER IN INDIA.*

By H. R. SPEYER, A.M.I.E.E.

In the two great Indian industrial centres alone there are at work at least 95 cotton and 45 jute mills. Excluding the miscellaneous industries, these aggregate no less than 200,000 I.H.P., of which total at the present time not even 10 per cent. is driven by electricity. It must therefore be clear to all that an excellent field is open to manufacturers for the installation of up-to-date electrical plant in India.

It would appear, however, that with few exceptions, British manufacturers of electrical machinery have in the past been reluctant to consider seriously the development of an Indian business, apparently not wishing to incur the initial expense essential for systematically canvassing the country. Half-measures have only too frequently been adopted by British firms by reason of their allocating their selling agency to established commercial firms in India on a commission basis, and almost without exception this method has proved unsatisfactory.

Electrical machinery quite unsuited to the working conditions prevalent in India has been sent to that country, and proving unsatisfactory has led mill-owners and their engineers to regard with keen disfavour electric plant for mill or factory working.

It is absolutely necessary for an engineer to be on the spot to nurse carefully any new electric power installation during the first 18 months or two years, or until the mill-owner or his engineers have gained complete confidence in the working of the plant. Only recently two important electrification schemes carried out by one of the leading British manufacturing firms were superseded by steam plant, owing solely to the lack of qualified supervision on the part of the manufacturer's engineer during the erection and probational period.

There is no doubt whatever that the time has now come for British electrical manufacturers to realise that if they wish for a fair percentage of the Indian electrical trade, they must be prepared to send out to the country their very best power men and not merely one commercial engineer. They must further be prepared to establish themselves on their own account in at least the two largest industrial centres of India, and be prepared to undertake the electrification of mills and factories from A to Z and not against c.i.f. or f.o.b. prices. This method would ensure the confidence of mill-owners and their engineers, and such British firms as were established in India in this way would be able in a very short time to build up a lucrative business.

The pioneering work may now be regarded as having been accomplished, and the field for electrical power for industrial purposes in India to-day, is one which if handled to advantage by engineers of experience should yield a handsome return to the manufacturers.

Since 1907 electrical imports have increased from £155,000 to £198,000, while steam plant imports have fallen from £800,000 to £310 000 in 1912.

During the last few years a very great proportion of the electrical plant installed in India, together with hydraulic and steam turbines, has been supplied from the Continent. Table I embodies the chief data of the five most important public electric supply undertakings in India; of 66,900 KW. of plant installed in these stations Switzerland has supplied 54,000 KW., England only 7,500 KW., and the United States 5,400 KW. of the prime-movers, whilst Germany has supplied no less than 32,000 KW., the United States 17,000 KW., Switzerland 10,000 KW., and England only 7,500 KW. of the electrical generating plant. In the author's opinion this is due chiefly to the greater standardisation covering a large range of voltages, in many cases from 220 to 6,000 volts, which allows foreign manufacturers many opportunities of putting forward standard plant where British manufacturers are obliged to quote higher prices to cover special construction; and in addition the time required for delivery of the plant in the case of the British firms will in the majority of cases be considerably in excess of that of the Continental firms. It must also be borne in mind that Continental makers are fully alive to the conditions under which electrical plant has to work in India, and have spent both time and money in experiments before deciding on the

* From the *Journal* of the INSTITUTION OF ELECTRICAL ENGINEERS (Abstract).

standardisation of plant intended for export to a tropical country. Except in some isolated cases, however, the same cannot be said of the majority of British electrical manufacturers, or else the author's experience has been unfortunate. The reason for this deplorable lack of enterprise appears in the majority of cases to be due simply to the lack of experience on the part of British electrical firms of the unfavourable conditions prevalent in India; and as soon as greater experience has been gained with the working conditions, it is to be hoped that British firms will bring their manufactures into line to meet the requirements of the Indian market.

It must be remembered that during the Indian "rainy" season, which lasts each year from June to October, the humidity reaches a figure of 95 per cent., with a temperature often of 98° F., and in the mills, factories, and engine room a temperature of 115-120° F. is often recorded. The temperature of water available for condensing purposes during the hot months, even when taken direct from the river or other sources of supply, often reaches 95° F., with the result that in the case of turbine plant, the economical steam consumption of which depends so largely on a good vacuum, it is essential to install condensing plant of a much larger capacity than is usual at home.

The effect of these adverse climatic conditions on the insulation of electrical apparatus for high-tension plant recently led to a controversy as to whether it was advisable to install 6,000-volt motors, at which pressure a supply of electricity for power purposes is available at cheap rates in two of the largest industrial centres in India, or whether it was preferable to interpose transforming plant, reducing the pressure to 500 volts for the supply to the motors. A large percentage of "burn-outs" on low-pressure motors (220-500 volts) has been directly traceable to the humidity, and it was thought by a number of engineers that the installation of high-pressure motors would be coupled with the risk of a still greater number of breakdowns due to this cause. It seems, however, to the author that the insulation on the average low-tension motor to prevent internal short-circuiting between successive turns due to the difference of potential between them, is insufficient to prevent the percolation of moisture from an external source, whereas the insulation necessary on 6,000-volt mains to prevent internal short-circuiting due to the potential difference between successive layers, is more than sufficient to prevent the percolation of moisture from an outside source. The author has in many cases supervised the installation of motors to run at 6,000 volts, and, with one exception, excellent results have been obtained.

Another factor which has hampered the development of electricity for industrial purposes in India during recent years has been the lack of English capital for projected industrial enterprises for utilising either water power or coal near the pit's mouth for the generation of electric power for transmission at a cheap rate for mill and factory use.

In the collieries of Bengal, which raise no less than 12,000,000 tons of coal per annum, a sound practical scheme was projected a few years ago for the centralisation of a power house for supplying electric power to the collieries in general, but owing to the lack of both capital and co-operation between colliery owners, the scheme fell through, with the result that there are now scattered over the coalfields a number of small electric power houses working with both unfavourable power and diversity factors, so that the economy it was hoped to achieve by the use of electric power, has to a great extent not been realised. The coal consumption at the collieries indicates that at least 85,000 B.H.P. is awaiting electrification.

Another favourable project which fell through owing to lack of capital was the Mourbhunj water-power scheme, which contemplates harnessing the water power available at Mourbhunj for providing a cheap source of electric supply to the mills and factories in and about Calcutta. Taking into consideration the fact that the 85 mills at work in the vicinity of Calcutta utilise altogether approximately 100,000 I.H.P., the success of this scheme would have been assured, as it is quite possible that had capital been forthcoming, substantial guarantees would have been obtained from the mills and factories for the supply of current to replace existing steam plant. It is an encouraging fact that the Tata hydro-electric scheme has been realised in Bombay, but it is to be regretted that the whole of the capital had to be found in India after an opportunity had been given to English capitalists.

TABLE I.—PUBLIC ELECTRIC SUPPLY COMPANIES IN INDIA.

Company.	Inaugurated.	Power.	System. Voltage and frequency.	Station capacity in KW.	Connections. Lighting and fans in KW.	Horse-power of motors.	Tariffs.		Country of origin.	
							Lighting and fans.	Power.	Prime movers.	Electrical plant.
Tata Hydro-electric Power Co.	1911	hydraulic	6,600; 100,000; 2,200. Three-phase, 50 cycles.	32,000	400	50,000 (including extension)	1·25d.	0·5d.	Switzerland	Germany U.S.A.
Mysore Government Cauvery Falls Co.	1900	,,	2,300; 35,000; 2,300. Three-phase, 25 cycles.	12,000 (including extensions)	400	9,000 (excluding extension)	3d.-2·5d.	0·5d.-0·25d.	,,	U.S.A.
Calcutta Electric Supply Corporation	1898	steam	6,000. Three-phase, 50 cycles. 440/225 C.C.	10,000	18,862	6,200	6d.-3d.	1d.-0·6d.	,,	(generators) Switzerland (switchboard) England
Bombay Electric Supply and Tramway Co.	1905	,,	5,500. Three-phase, 50 cycles. 500/225 C.C.	7,000	7,025	2,850	4·5d.	1·5d.-0·8d.	England	England
Rangoon Electric Tramway and Supply Co.	—	,,	—	5,900	—	—	—	—	U.S.A. England	U.S.A. England

Total station capacity 66,900 KW., of which Switzerland supplied 54,000 KW., England 7,500 KW., and U.S.A. 5,400 KW. of prime-movers; Germany 32,000 KW., U.S.A. 17,400 KW., Switzerland 10,000 KW., England 7,500 KW. of electric generating plant.

Had the money been found in England there is little doubt that arrangements could have been made for the installation of English plant, whereas with the exception of the motors and transformers for the mills, the whole of the 60,000 H.P. of generating and transmitting plant has been purchased from the Continent and from America (see Table I).

There is, however, no doubt that the visit of His Majesty King George to India in 1911 served in a large measure to focus the attention of the British public on the country, and from the glowing reports which appeared at the time on the prosperity of the country and its development, it is to be hoped that financiers will have at last realised that the resources of India offer a reliable and safe investment for capital.

(To be continued.)

LOAD FACTOR, OUTPUT AND COST.

BY C. ASHMORE BAKER, A.M.I.E.E.

IN the field of electricity supply, when one attempts to compare the economic results of one undertaking with another, one finds the most astonishing discordance between concerns working under substantially similar conditions as regards matters of primary importance such as size, load factor, locality, &c.

Take, for instance, two towns, A and B. Both inland provincial towns, outside the coal areas, both municipal undertakings, both giving three-wire direct-current supplies at approximately the same voltage, both having maximum loads equal within 10 per cent., and almost exactly equal load factors, and yet the working expenses per unit sold are in one case over 50 per cent. higher than they are in the other.

Again, compare A and C, whose load factors are not very different, 17·6 and 16·7 respectively, and yet although their maximum loads vary as 1 : 22, their respective total working costs vary only as 1 : 1·13 (13 per cent.).

I mention these facts for the purpose of drawing attention to the danger of comparing one undertaking with another, or with a relatively small group of others selected according to some particular plan.

In order to obtain a knowledge of the relative economy of any undertaking, it should be compared with a very large number of other undertakings, so that the influences of purely local or psychological conditions may become negligible.

It is the object of this article to suggest means for such comparisons, to illustrate methods of applying them, and to draw attention to some of the more interesting results thus obtained.

Influence of the Size of Undertaking on its Working Costs.—The data I have made use of in preparing this article are those comprised in the annual tables of the *Electrical Times* for the year 1911-12.

If we take two columns of these tables, such, for instance, as maximum load and total working costs per unit, and if we plot them on squared paper, it will be obvious at first glance that although the variation from the mean may be considerable in the case of any one undertaking, there is, nevertheless, a tendency for

the two co-ordinates to be related in a definite way, which might be represented by a mean curve drawn through the points plotted.

We can obtain a closer approximation to what this mean curve should be like, if, instead of plotting each undertaking separately, we plot the averages of similar groups. Taking the returns already alluded to relating to local authorities, and omitting all such undertakings as purchase a supply in bulk, we have a list of some 200 concerns. Arranging these in the order of their maximum

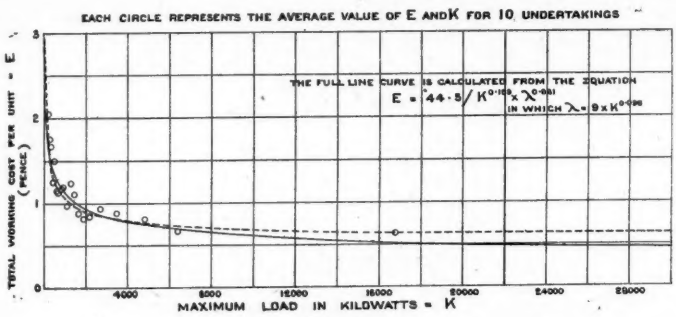

EACH CIRCLE REPRESENTS THE AVERAGE VALUE OF E AND K FOR 10 UNDERTAKINGS
THE FULL LINE CURVE IS CALCULATED FROM THE EQUATION
E = 44·5/ K^0·189 × λ^0·831
IN WHICH λ = 9 × K^0·196
TOTAL WORKING COST PER UNIT = E (PENCE)
MAXIMUM LOAD IN KILOWATTS = K

FIG. 1.

loads, and subdividing them into groups of 10 consecutive towns each, we can plot the mean load of each group of 10 towns against the mean of their total working costs; this will give us the points plotted in fig. 1.

In this diagram, although the values plotted are still somewhat irregular, they indicate that a mean curve drawn through them would show a close family resemblance to an hyperbola. If instead of plotting our co-ordinates directly we plot their logarithms as is done in fig. 2, it at once becomes obvious that the relation between the co-ordinates is so nearly a straight-line law that any departure therefrom is not of great importance. Now it is a simple matter to find the mean of a number of

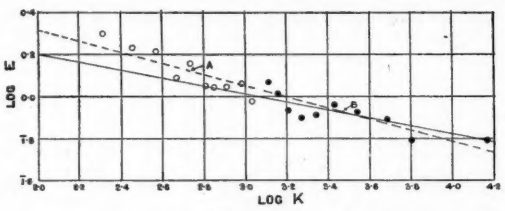


FIG. 2.

co-ordinates following a straight-line law. All we have to do in this case is to divide our undertakings into two groups, one containing the 100 larger concerns, and the other the 100 smaller ones. For each of these two groups we add together the logs of all the maximum loads and likewise the logs of all the working costs; we then divide each of these four totals by 100, and we have as the result two pairs of co-ordinates which we can plot on our squared paper (A and B, fig. 2). A straight line ruled through these two points represents the mean of our separately plotted co-ordinates. The empirical law connecting maximum load and cost per unit sold (neglecting for the moment the influence of load factor) for municipal electric supply undertakings is found by projecting the straight line back until it intersects the vertical ordinate representing zero on the horizontal scale, and calling E the cost per unit sold and K the maximum load in kilowatts, we have—

$$\text{Log } E = 0{\cdot}84 - (\log K\ 0{\cdot}265),$$

or

$$E = 7/K^{0{\cdot}265} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

But here a digression is necessary. The cost of production is influenced by the load factor of any given undertaking, as well as

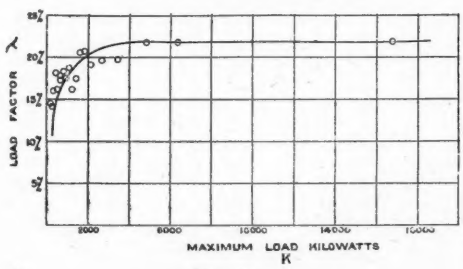


FIG. 3.

by its output—so much so, that it is useless to attempt to establish any standard of comparison which does not take this influence into account.

We may ascertain approximately the influence of load factor on the cost of production in a manner similar to that employed for ascertaining the influence of maximum output, namely, by setting down our list of towns in the order of their respective load factors, instead of in that of their respective loads. But there is a distinct relation between "maximum output" and "load factor," as will be seen from an examination of fig. 3, in which are plotted as co-ordinates the mean maximum loads of our 20 groups of towns and their corresponding load factors (indicated by the symbol λ). In order to discover the influence of λ on the cost of production, we must be able to eliminate the influence of K and *vice versâ*.

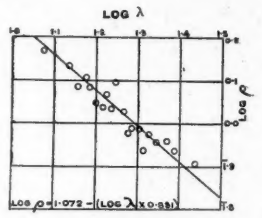


FIG. 4.

Now, it will be seen on examining fig. 3 that for plants above a certain size, the load factor does not vary much as a function of output, thus for the first three groups of towns its average is constant at 21·7 per cent., while the whole of the first 10 groups comprising 100 undertakings give an average load factor of over 20 per cent. If, therefore, we calculate our K E formula afresh from the results obtained by these 100 undertakings, we shall obtain an equation connecting E and K, in which the disturbing element, λ enters to a negligible extent.

This equation is $\log E = 0{\cdot}577 - (\log K \times 0{\cdot}189)$,

or

$$E = 3{\cdot}78/K^{0{\cdot}189} \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

and the logarithmic graph is represented in fig. 2. Here it will be seen that the full line which represents this equation passes through the mean of the first 10 points, represented by dots; the remaining 10 points represented by open circles, and composed of groups of towns having generally somewhat smaller load factors, fall above the full line.

We are now in a position to study separately the influence of load factor on the working costs, and for this purpose we can employ, as has been said, the same method as that adopted for studying the influence of maximum load.

Thus, if we re-arrange our towns in groups of 10 in the order of *load factor*, commencing with the highest load factors, we again obtain 20 groups of undertakings, each of which will give us a pair of co-ordinates, but in these co-ordinates the disturbing influence of maximum load comes in, because the average value of the load is not the same for each group. If, however, we calculate from equation (2) what the cost should be with the average load factor of the 100 largest undertakings, and divide the actual average cost by this calculated figure, we shall obtain ratios varying from group to

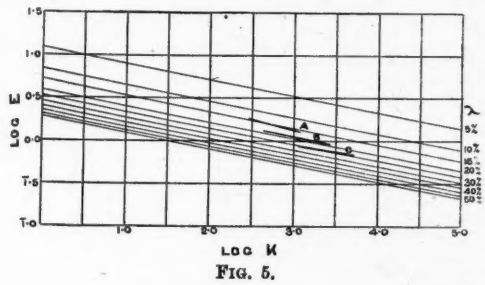


FIG. 5.

group according to the mean load factor of each group, which ratios can be plotted as co-ordinates of their corresponding load factors. The logs of these co-ordinates are plotted in fig. 4.

The equation corresponding with this diagram, calling ρ the ratio of the actual to the calculated value of E, is

$$\text{Log } \rho = 1{\cdot}072 - (\log \lambda \times 0{\cdot}83), \text{ or}$$

$$\rho = 11{\cdot}8/\lambda^{0{\cdot}831} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (3)$$

The quantity ρ is obviously a coefficient by which we must multiply a result obtained from equation (2), in order to make due allowance for the influence of load factor.

These two equations combine into the expression

$$E = \beta/(K^{n} \times \lambda^{\eta}),$$

in which E is the total cost of production per unit sold, β is a constant representing the value of E when K and λ are unity, and n and η are powers of K and λ respectively. Giving β, n and η their numerical values, we obtain the equation

$$E = 44{\cdot}5/(K^{0{\cdot}189} \times \lambda^{0{\cdot}83}) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4)$$

From this equation a diagram (fig. 5) has been prepared, showing the logarithms of E for various values of K and λ. It will be

seen from this diagram that for each value of λ a straight line slopes downward from left to right. The height of its intersection with the ordinate representing 0 is obviously the calculated value of E when K = 1, viz., $\beta/\lambda^{0.881}$, while the slope of the line (that is, the vertical distance of any point on it below the point of origin divided by the horizontal distance of the same point from zero) is 0·189.

Component Items in the Cost of Production.—The method we have employed for discovering an equation correlating the total cost of production per unit sold with K the maximum load for the year, and with λ the load factor, may be employed in an exactly similar manner in order to obtain analogous equations, correlating K and λ with the separate heads of expenditure of which E is made up.

It is not necessary to enter into the details of these calculations. It will be sufficient for the purposes of this article if the results are available. These are given in Table I, in which the constant β and the exponents n and η of K and λ respectively are given for each item. These data are calculated from the averages of 200 municipal undertakings.

Symbol.	Description of item.	Log β	β	n	η
F	Coal and other fuel	0·694	4·95	0·193	0·418
O	Oil, waste water and stores...	0·314	2·06	0·351	0·584
W	Wages of workmen	1·394	24·8	0·332	0·951
R	Repairs and maintenance ...	0·716	5·19	0·125	0·894
T	Rent, rates and taxes ...	0·267	1·85	0·092	0 821
M	Management, salaries, office and legal expenses, insurance, &c.	1·470	29·5	0·251	1 174
E	Total working costs... ...	1·649	44·5	0·189	0·831
P	Average price received (total supply) ...	1·949	88·9	0·112	1·027

As an illustration of the use of this table, suppose we wish to find out if the cost per unit for, say, fuel, in a concern in which we are interested is above or below the municipal average.

The maximum load and the load factor we will assume to be 3,000 KW. and 16 per cent. respectively, while the actual cost for fuel is, let us say, 0·3d. per unit sold.

Now the average municipal cost is—

$$F = 4{\cdot}95/(3{,}000^{0.193} \times 16^{0.418}), \text{ whence } F = 0{\cdot}331.$$

The fuel costs for the undertaking in question are thus (0·3/0 331) × 100 = 91 per cent., or 9 per cent. below the general average.

(To be continued.)

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Cab Signalling.

In view of the large number of mistakes that have been made by the Board of Trade and the railways respecting electrical signalling equipment, Mr. Ogden's exceedingly informing letter is very opportune.

Since Mr. Ogden's criticisms appeared, one technical journal has named the British railways that have adopted or tested cab signalling systems of various sorts. But judging from well-known facts, one is tempted to marvel at the unscientific and unbusiness-like way in which the railways and the Board of Trade have handled this matter.

If a real and satisfactory preventive of a certain numerous class of wrecks still remained undiscovered, one could understand why British railways in some instances had adopted, and in other cases were still experimenting with, very faulty kinds of cab signals. But inasmuch as a genuine preventive has been known to railway officials for at least four years, and to thousands of other persons for about half that time, two things are, to put it mildly, quite strange. One is that no railway has even tested the only satisfactory cab signal extant; the other is that no Board of Trade Inspecting Officer has ever taken the trouble to recommend a trial of this signal.

Some time ago, one technical editor published, as his own opinion, the statement that Mr. Dammond had "the sanest ideas" as to cab signals that he (the editor) had ever seen presented. Those who, like myself, saw Mr. Dammond's full-size tests, and have no interest in any signalling system, are strongly of the same opinion.

I think Mr. Acfield knows very well that Mr. Dammond has "made an advance" on the Great Western cab signal. Why, then, has the Great Western been allowed, and the Dammond refused, a test on the Midland Railway?

Along with other visitors, I was invited by Mr. Dammond to produce as many earths as we wanted in his full-size equipment. We did so, and every resulting error was a safe one. We were also invited to produce any number and any combination of earths and open circuits we wanted; and we did not get a dangerous error any time we tried. Has not Mr. Acfield had the same opportunities as we to test the Dammond system?

Will the "railophone" or the Great Western equipment on the Midland Railway pass these important tests?

May 24th, 1915. **Traveller.**

Cable Shortage.

I happened to visit a job the other day (a three-phase one) and found two men about to pull in six 7/14 cable into two pipes. The total length of the pipes was 54 ft. 2 in., and allowing very sparingly for tails at main switch, motor and starter, I decided to cut each length 55 ft. — 6 × 55 ft., being a complete 110-yard coil. A coil of cable by a well-known maker was unwrapped, measured out and cut, but to my, I may say disgust, the last length only measured 42 ft. 7 in., making a total of 317 ft. 7 in., or a shortage of 12 ft. 5 in.

Out of curiosity I measured two coils of a smaller size and found one to be 1½ yards short, while the other one was actually 5 yards over. I should very much like to know how the cable makers arrive at the length before labelling the coils 110 yards. Is it weighed or measured? During these times of keen competition and dear material, every contractor requires his full pound of flesh, and 1,760 yards to the mile.

Coils of cable, such as the one I have described, may mean the difference between profit and loss, and I would be interested to find out other contractors' experiences in this direction.

If one item on the label is incorrect, namely, the length, what satisfaction is there in insisting on seeing the label for insulation resistance, &c.?

I trust that a few observations like this may lead to closer attention on the part of our manufacturers to ensure weights and measures, as well as their well-known quality, thus combining quantity and quality.

Contractor.

Automatic-Lift Accidents.

I am glad that such an authority as Mr. Frank Broadbent has brought up the subject of electric-lift accidents.

Lift accidents seem generally to fall under two headings, namely, those in which injuries are caused to persons by the opening of doors when the lift is away, and those in which injury is caused to the person in the cage or car. My experience goes to show that the latter are the more common.

As Mr. Broadbent has dealt with the first, I will confine myself to the second class.

First case. Car switch lift, serving four floors of offices. On one occasion, when the lift was ascending, the foot of a lady passenger projected beyond the edge of the car, and became trapped at the next landing. As a result the toes had to be amputated.

Second case. Full automatic push-button lift with gate contacts. A visitor accompanied by a boy ascended, the boy being told to wait in the lift. For some reason the gate was closed; it could never be ascertained whether the lift was called, or the boy pushed one of the buttons, but it was clear that he attempted to get out while the lift was moving, with fatal results.

Third case. This only occurred a few months ago, and may be described rather more fully. The lift in question was situated in a warehouse, and was chiefly used for packages about 2 ft. cube, averaging ¾ cwt. Its travel was about 100 ft. per minute, was controlled by a handrope, and worked by a regular attendant, a man rather past middle age, but quite able bodied. There were the usual double-pole switch and fuses in the basement, and an additional double-pole switch and fuses on the top floor, where the motor, gear, &c., were also situated.

On hearing a cry one day a man, working on the top floor, rushed over and opened the double-pole switch. The unfortunate lift operator was found so badly crushed between the floor of the cage and the landing that the flooring had to be cut away in order to release him. As life was extinct and there were no eye-witnesses, what actually occurred could only be conjectured, but what apparently happened was this: The cage was well loaded, the packages being placed on top of one another, leaving very little room for the operator. One of the packages appeared to have toppled over and knocked the attendant forward, possibly pinning him down or jamming the handrope, with fatal results. A fatality having somewhat similar features is recorded in the ELECTRICAL REVIEW, of May 21st, on page 728. Other instances could be given, but the two points I wish to raise are:—

First, that every lift should be fitted with gates to the cage or car, preferably with gate contacts.

Secondly, that the time is more than ripe for a clause to be embodied in the Home Office Regulations to cover electric lifts. Apparently as long as the motor is earthed and the fuses are not on the live side of the switch nothing else matters.

It is, perhaps, hardly necessary to mention that every lift should be periodically inspected by someone competent to do so.

London, W.C., *May 24th*, 1915. **Ernest F. Butler.**

P.S.—I should be glad to know if any reader has succeeded in maintaining an arc on a door or gate contact when opened. I often tried to do so, but have only been successful on one occasion.

In connection with Mr. Broadbent's excellent article under the above heading, which appeared in your issue of May 14th, we notice that he draws attention to two points in the design of electro-mechanical locking gear, which are capable of improvement:—

The first point is one which is easily overcome by placing the lever which actually locks the gates either at the "far" side or at the back of the car. This lever should rotate a shaft which is enclosed in a tube screwed into the lock, so that it is quite impossible to tamper even wilfully with the locking mechanism; such an arrangement is shown in fig. 1. The lock is fixed in the centre of the gate, as this is the point at which most force is applied; this is important, as with some locks fixed at the top of the gate it is often possible, by pulling at the lower end of the leading spigot of the gate, to bend it in such a manner as to release the catch.

The second point is the most important, as it is here that a real danger exists. In the majority of cases, and unless some special

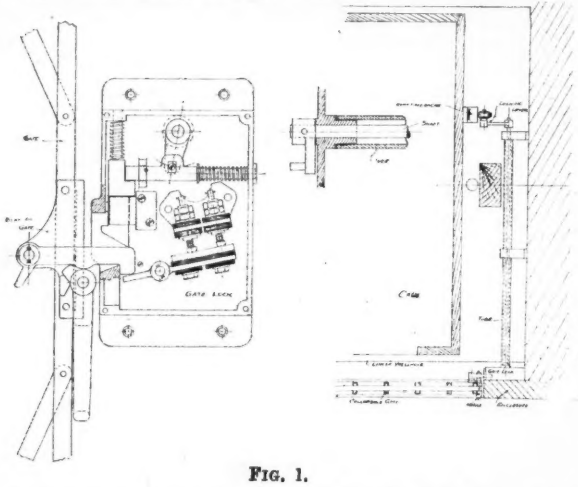


FIG. 1.

device, such as we illustrate in fig. 2, is fitted, it is possible for anyone to open a landing gate or door as the lift cage passes. To obviate this possibility, we have designed a "pilot" or "car switch," which, when rotated into the "up" or "down" positions, operates a movable "ramp" through the medium of Bowden wire mechanism, in such a manner that the "ramp" is raised, and the gate actually locked, before the lift moves away from the floor, also the gates on the floors which the lift passes are not unlocked, and it is thus quite impossible for an accident such as Mr. Broadbent has described to take place. The only gate which is

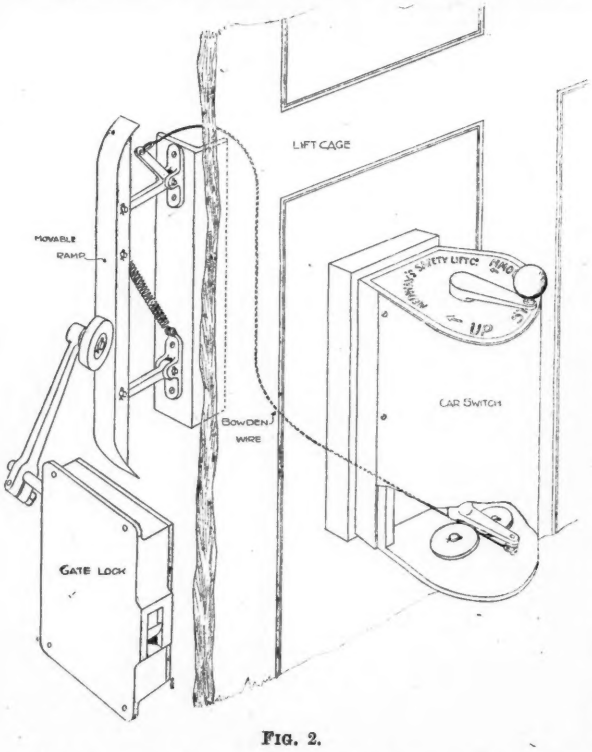


FIG. 2.

unlocked is that on the floor at which the lift stops, and even this gate is not released until the lift has come to rest by the car switch handle being moved to the "off" position.

The same arrangement can be fitted to push-button lifts and the "ramp" can be lifted either mechanically by the closing of the inner cage gate, or by a solenoid.

It will be appreciated that this device is extremely simple and unlikely to get out of order, and it is, moreover, a purely mechanical job which could not be "short-circulated" by a lazy or incompetent engineer-in-charge. Unfortunately, however, these extra safety devices increase the first cost of the lift, and unless the purchaser is an engineer or employs a consulting engineer to act for him, the necessity and advantage of these safeguards is often not appreciated.

The defects which Mr. Broadbent calls attention to exist in a greater or less degree in the majority of lifts in this country, while, in addition, in many cases no lock of any kind is fitted, and when it is considered that the electric passenger lift is as much a public vehicle as say the motor-omnibus or taxi-cab, it is surprising that no special rules have been drawn up, to enforce the adoption and maintenance of suitable safety appliances.

For **Medway's Safety Lift Company.**
M. D. SCOTT.

London, S.E., *May 25th*, 1915.

The article in your this week's issue by Mr. Frank Broadbent does not do justice to the efficiency of the safety devices which are at present being used by the best makers. The form of door-latch indicated by his sketch is, doubtless, the prototype of these devices, but the existing mechanisms do not permit of the conditions arising which Mr. Broadbent rightly criticises. The requirements of a satisfactory lock are:—

1. It must be impossible to unlatch any door normally, unless the lift be at that door.
2. It must be impossible to move the car if any door be open.
3. It must be impossible to move the car from any door unless that door be latched.
4. It must be impossible to unlatch the door at which the car is standing immediately current is applied for moving the car.
5. It must be impossible to unlatch the door while the car is passing that door without stopping.
6. The car at the landing should put the mechanism in a permissible condition for unlatching the door without actually unlatching it. A manual operation must follow to unlatch the door.
7. The device must be independent of springs or other appliances for its safe functioning.

Devices are at present in use which fulfil all these conditions, and the writer ventures to suggest that had such a device been used the accident could not have taken place.

Surely this is an opportune moment for inducing some recognised authority to formulate a set of rules to which all lift makers must conform if they desire to have their lift passed for service. Such rules exist in a great many foreign cities, and are generally administered by the police. The London County Council could make itself the authority in this matter and insist that no lift be passed for service until it were officially inspected and approved, a procedure which this body has adopted in other instances where public safety is concerned.

Gilbert Rosenbusch.

London, S.W., *May 15th*, 1915.

INDIAN NOTES.

[FROM OUR SPECIAL CORRESPONDENT.]

HYDERABAD (Deccan) is the premier Native State in India. It has an area of 82,698 square miles and a population of 13½ millions. The principal city is Hyderabad, and not far distant is the military cantonment of Secunderabad, where a British infantry regiment is generally located. Electric power was first made use of in the Nizams' palaces about 10 years ago. Additional plant was laid down from time to time, and now the capital city can boast of a very fine electric installation equipped on the most modern lines. It is expected that two new steam turbine sets, each of 1,500 KW. capacity at 3,300 volts A.C., will shortly be put into commission; these should be sufficient for all ordinary wants for several years to come. The greater part of the electric power is used for lighting and fans for the Nizams' palaces—of which there are several.

The Mint and State workshops also consume a fair proportion of the output, and the private consumer and street lighting call for a considerable load. The street lighting is on the glow lamp series principle, with constant current transformers in circuit, and automatic "cut-ins" in case of failure of individual lamps. Most of the principal streets of both Hyderabad and Secunderabad are lit with very satisfactory results. Mr. Gamlen is responsible for the design and lay-out of the modern part of the electric equipment, and has carried out his work in a highly commendable manner. In his twofold capacity as mint master and chief electrical engineer he is a tremendously busy man, and gives the State the best that is in him.

A huge dam is now being built not far from the lake to impound the surplus water of an extensive catchment basin. Primarily this is intended to prevent the possibility of any further floods—such as the colossal one of a few years back, which caused untold damage to life and property; incidentally, it is expected that the water throttled back by this dam may at some time be used as "white coal," and turned to account hydro-electrically.

From the size and population of Hyderabad State it may be thought that large possibilities of electrical business should present themselves; but just yet this is not so. The population is mainly agricultural, growing cotton, rice and general foodstuffs. There are a few manufacturing industries such as spinning, weaving and ginning mills, but these are in a comparatively small way. Under the sway, however, of a progressive ruler, whose word is absolute law, one may expect developments in electrical as well as in other engineering lines.

THE POWER SUPPLY OF THE CENTRAL MINING-RAND MINES GROUP.

Mr. J. H. Rider's paper, of which we have published an abstract in recent issues, was discussed at a meeting of the Yorkshire Local Section of the Institution of Electrical Engineers at Leeds on Wednesday, May 12th.

Mr. Wright said he felt, as a manufacturer, that there were a good many points of great value in the paper, for the reason that it was often said that manufacturers' failings, especially in regard to plant and switchgear, were particularly to be found in the fact that they limited their experiences to the actual process of manufacture, and not to the actual working of the machinery and switchgear which they produced. Therefore, the failures mention in the paper were of great value to manufacturers of plant. It was often the practice of manufacturers of three-phase motors to earth one of the slip rings, but he assumed that that method would not be allowable in any of the motors installed on the supply dealt with by the author, for the reason that if they had an earthed slip ring and a liquid starter, when they started up they would have one of the phases short-circuited. He did not think it was good practice to earth one of the slip rings. With reference to the dimensions of the minimum radial air gap, it worked out as a very fair average for moderate speed motors, but he did not quite understand the last figure in the formula, namely, "minus .25."

Mr. Burnand said he had been interested in the braking with reverse current on the three-phase motors. The amount of energy wasted for the purpose of braking was really very large, and he wondered if the author had had any experience of putting direct current on to the primary of the three-phase winding motor; by that means they got quite an efficient brake, though he doubted whether they would brake down to quite as low a speed as they would be using the eddy-current brake described in the paper. The saving of energy would, of course, be very great—they would only use, perhaps, about 5 per cent. of what was used by reverse current braking. He did not care very much for carbon brushes on the slip rings, preferring copper cores impregnated with graphite. With regard to oil rings, it was always desirable to be able to see the rings move, and there ought to be at least two rings. From the rather painful record of troubles, it appeared that the motors were all supplied by firms of world-wide repute, and he thought the fact that troubles such as the author had mentioned were possible, pointed to a very loose and unbalanced organisation. Many engineering works were run by commercial men rather than by engineers, and if the latter had control they would get a better balanced system of inspection and supervision than had previously been the case.

Mr. Shepherd said they were indebted to the author for giving them such a full and candid opinion of the troubles which he, in common with all users of large plant, had found. With the experience which people had had now there was no excuse for any motor having a frame which was not of sufficient stiffness, particularly when such machines were subject to rapid reversals. Soft or loose cores were quite inexcusable. He knew of several cases where very large plants had given way owing to the external dovetail keys being insufficient in size and insufficiently secured in the circumferential frames to which they were attached. He had always insisted on the core plates being secured to external dovetails, and, as a further precaution, he had always found it better to fill in all spaces—if there were any between the keys—with white metal. He thought other people should follow the author's example in giving descriptions of plant which gave trouble or, rather, descriptions of the trouble experienced, because then engineers could soon come to some definite opinion as to what plant was good and what was bad.

Mr. Yerbury said he was pleased the author had mentioned the troubles he had experienced. He recalled instances of motors with too fine clearances, and in which the slip rings had been made of what appeared to be yellow brass instead of iron or gun metal, and where springs had entirely failed in brush-holders in a short time owing to dust accumulating in the holders. With regard to starting and running resistances, he found in many cases that there had not been a sufficient clearance for air—instead of its being properly circulated it had become stagnant. He was glad the author pointed out the desirability of modifying the proposals of the Engineering Standards Committee with regard to machines and apparatus designed to work within certain limits of pressure. He had had experience of rheostats failing when the pressure was reduced, owing to over-heating having taken place, and had always found that an ample margin of copper and attention to small details had proved a very desirable investment.

Mr. Thackery drew attention to the question of who decided the purchasing of the machinery in South Africa; he supposed it was purchased against the specification which somebody had drawn up. He did not think it was altogether the manufacturer who was at fault, because if he put forward against a specification what was demanded, the order generally went to the lowest tenderer, and if there was no specification that the manufacturer was working against, it would not be wise for him to put in big air gaps and open slots, because he would lose the order on price. It was far better to have a motor which would stand rough usage than one which was very highly efficient, because the cost of repairing the machine was so much more than the extra cost of a reliable motor.

Mr. McClay said the author did not tell them whether the mining companies found the change-over from steam to electric operation financially advantageous. No doubt, from the power company's point of view, the whole thing had been financially successful, but he would like to know what it had been from the consumer's point of view. In this country they found it extremely difficult to persuade people to use electricity and to convince them of the savings to be effected by so doing, and he would like to know how they had done it on such an enormous scale in South Africa.

The Chairman (Mr. T. Roles) said he would like to know how the concerns for which the author had acted, viewed the matter of buying current from a power company as against providing plant of their own. In Yorkshire they often had great trouble in persuading large power users to obtain their supply in bulk from a power supply undertaking, and the private plant still flourished to a very great extent, notwithstanding the fact that prices for current were in many cases very cheap. He agreed with the author in regard to having a proper reserve of generating and transforming plant. Many undertakings had experienced trouble owing to having a very small margin of plant, and many corporation undertakings had been starved of the necessary plant to keep up a proper supply, and had had to pay for it as a result. His idea of reserve plant was that in the case of, say, four turbines, they should have one machine always standing by and another one which could be taken down for repairs at any time.

Mr. Rider, in replying to the discussion, said he had never come across a slip-ring motor with one ring earthed. He had not tried using direct current on three-phase stators for braking, because he considered that the complication was too great and he would have had to use a motor generator. If he had to go in for direct current at all, he would rather have a Ward Leonard winder and have done with it. The troubles he had mentioned taught a great deal if approached in the right spirit. Regarding Mr. Burnand's remarks as to the running of engineering shops, he did not agree that if they were run by engineering men instead of by commercial men things would be better. It all depended on the experience of the engineer. It was no good for an engineer who had experience only in the shops as a designer or as a manufacturer, to think that he knew all about the way to manufacture—that was, to produce a machine which would be satisfactory to the purchaser. The man might know a great deal more about manufacturing than the consumer, but it seldom happened that he knew anything at all about the way a machine which he produced behaved in after life. If engineers who designed machines had to be in responsible charge of a few of them for six months, with the threat of the "sack" if they broke down, they would, he thought, alter a good many of their designs. As the charge for energy was irrespective of power factor or load factor, or anything of that kind—merely a flat rate being charged—the question of maximum demand did not come in at all; all they had to do was to give the power company notice when they were putting down any new plant on the mains, in order that the supply could be ready. If a motor would not last for 15 years it was not worth buying. The point raised by Mr. Thackery as to the purchasing of machinery was an important one. Why should a purchaser be blamed by anybody for taking the lowest offer? The purchaser came into the market and said to a body of presumably respectable contractors: "I want to buy such-and-such an article." He stated his requirements as clearly as he could, and said to the manufacturers—who said they knew all about manufacturing and the way the machine should be made—"What is your price?" The manufacturers fixed the price; not the purchaser. If a manufacturer came along and said: "I want £500 for that machine, and it ought to be £600," it was that man who was the dishonest one, and not the purchaser. If £600 was required for the machine, that amount should be asked for, and if a manufacturer came in and asked for £500 he was playing a low-down game on the purchaser in order to get the work for his shop, knowing he would give something that was not good. If the purchaser had a price put to him by the manufacturer he ought to be able to assume that he was dealing with an honest man, and was justified in taking the lowest price. In his own opinion an efficient machine was one which would do its work day in and day out as long as he wanted it to do it, and would not break down. In reply to Mr. McClay, he said that the change over from steam to electricity and from the old mine steam-driven compressors to the central air supply had been most successful from a financial point of view, and if anybody doubted the advisability of taking energy in large quantities from a respectable power company, he could assure them they need have no further hesitation at all. The firms looked upon the question of buying power from a company instead of getting it from their own plant from the point of view that if they put down a power station to electrify their mines it would cost, say, £750,000, and they could employ that money better in developing their mines. Therefore, they used the money in the mines, and the power company was left to raise the extra capital, and the firms bought their supply from the company. He thought that was a wise view to take, and he would always recommend anybody, if the circumstances were at all similar, to do the same thing. He expressed his agreement with the Chairman as to the desirability of having a reserve of generating plant of about 25 per cent.

THE BOMBAY HYDRO-ELECTRIC SCHEME.

(*Discussion in London on paper read by* Mr. Alfred Dickinson, M.I.E.E., *before the* Institution of Electrical Engineers, *April 29th*, 1915.)

The discussion in London was opened by Mr. Robert Hammond, who congratulated the author on a paper covering so many branches of engineering. The turbine plant operated under one of the highest heads so far used; it would be interesting to know why such a high transmission pressure as 100,000 volts had been adopted for such a short distance, and to what extent a saving in line copper balanced more expensive apparatus as compared with, say, a 60,000 or 70,000-volt line. He thought the vertical shaft type of Pelton wheel allowed of more nozzles being used than was the case with the type adopted. In America, he believed there had been trouble with the swinging of lines carried on suspension insulators.

Mr. T. Callender thought Bombay was to be congratulated on having such a scheme at its door, and on having made up its mind to do better than the conditions existing in English and Continental manufacturing cities and to preserve its beauty.

Mr. J. H. Rider regretted that so much of the plant was of foreign origin; he also thought that a great deal was risked in going in for such a high transmission pressure, and that the efficiency was not improved. There appeared to be a drop of 14 per cent. in line pressure, and that did not agree with a line efficiency of 93 per cent. mentioned. Two separately driven exciters were used, but if one were shut down, and the one running failed, the station would be shut down. Why were not the big units provided with their own exciters? Would it not have been better to use the same voltage for exciters and switch control, so that the battery for the latter could have been used as a stand-by for both services? From experience, he considered belt-driven governors an abomination; they should be direct driven, but the turbine makers apparently would not do this. The author appeared to have deliberately avoided earthing; on the Rand, owing to lightning, they had been driven to earthing at several points. The seven-strand transmission cable offered more surface for corrosion than a single cable. He noted that six-unit insulators were used; the same number of units were employed with only 80,000 volts on the Rand.

Mr. E. Doelly said the belt-driven governor was usual, although the rigid drive had been tried; maintenance trouble arose in the latter case from the transmission of shocks. The security of the pipe joints was due to the water pressure, and this type of joint had been used for over 2,000 ft. head.

Major-General Beresford-Lovett said this was the first instance of such a scheme being financed on commercial lines in India; the promoters had tried to raise the capital here, but had in the end to obtain it in India. They were wise in obtaining expert advice as to the site of the dams, as an earth fissure might wreck such a scheme; they were also fortunate in being able to rail their plant from the docks to the power house, as this was not usual in India.

Mr. G. V. Twiss congratulated the author on the transmission tower construction; he would have been satisfied with a test to three times working load. He thought the insulator system used on the Rand transmission was of the interlinked suspension type, which was 20 per cent. less effective than the type of suspension insulators used by the author.

Dr. Railing said he supposed the low cost of labour had a great deal to do with the practicability of the scheme. It was an instance of diversity factor at the generating end; the water was stored during three months and used over twelve months. Judging from the data given, the temperature rise allowance in the field coils of the machines at the receiving station seemed fairly high; he would be interested to know the power factor of the line with a view to ascertaining the efficiency.

Mr. G. F. Sills said in America single-phase transformers were usually adopted, possibly for ease of transport, and this practice was followed by the author, although it would appear that three-phase transformers were cheaper. He assumed that there had been some trouble in regard to right-of-way for the transmission. In Canada, the Hydro-Electric Commission had had to divert its 110,000-volt transmission route at Toronto to avoid crossing certain places, and the towers were placed in Lake Ontario.

The Author, in a short reply, pointed out that a scheme of that magnitude could not possibly have been carried out except by a combination of specialists, and any credit must be shared by those who had controlled the various sections of the work. In the lake area, as much as 540 in. of rain had fallen in 90 days, but some years it was much less. It was found that the valleys were full of land crab holes, indicating that water was always there, and this was one reason for the use of the sites chosen for the dams.

Petrograd Telephone System.—The Petrograd telephone concession lapses in 1919. Down to 1/14 January, 1914, the development had cost 9,195,303 roubles. The decision as to its further exploitation must be taken in 1916. It is calculated that by 1/14 November, 1919, the subscribers will number 75,000, and a further concession, say for 18-20 years, should be based on 150,000 subscribers by the end of that time.

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

6,971. "Cut-out device for dual aeroplane controls." G. Stannard. May 10th.

6,980. "Joint for an electric cable." A. E. Tanner & E. A. Claremont. May 10th.

6,991. "Short-time switch." Landis & Gyr Akt. Ges. May 10th. (Convention date, May 23rd, 1914, Germany.) (Complete.)

6,997. "Dynamo-electric machinery." Siemens-Schuckertwerke G.m.b.H. May 10th. (Convention date, May 11th, 1914, Germany.) (Complete.)

7,006. "Electrical toasting devices." E. C. R. Marks. May 10th. (Landers, Frary & Clark, United States.) (Complete.)

7,013. "Dynamo-electric machines, particularly applicable for engine-starting systems." C. F. Kettering & W. A. Chryst. May 10th. (Divided application on 13,022/14. Convention date, July 14th, 1913, United States.) (Complete.)

7,016. "Process for the manufacture of tapes containing parallel electric wires." A. de Capitani. May 10th. (Convention date, May 9th, 1914, Italy.) (Complete.)

7,080. "Electrical apparatus." British Thomson-Houston Co., Ltd. May 11th. (General Electric Co., United States.)

7,081. "Electrical apparatus." British Thomson-Houston Co., Ltd. May 11th (General Electric Co., United States.)

7,088. "Electric horns." A. H. Midgley & C. A. Vandervell. May 11th. (Complete.)

7,092. "Controlling means for electrically-propelled vessels." Svenska Turbinfabriks Aktiebolaget Ljungstrom. May 11th. (Convention date, September 17th, 1914, Sweden.) (Complete.)

7,112. "Thermostats." H. E. Moul. May 12th.

7,177. "Switching-over apparatus for electrical lighting installations for railway trains and the like." H. Grob. May 12th. (Complete.)

7,178. "Sparking plugs." E. N. Kennedy. May 13th.

7,206. "Electric starters for internal-combustion engines." A. H. Midgley and C. A. Vandervell. May 13th. (Complete.)

7,211. "Electric circuit controlling devices." British Thomson-Houston Co., Ltd. May 13th. (General Electric Co., United States.)

7,213. "Electric cell, battery, or refill for use in connection with portable electric lamps and for other purposes." L. Wahl. May 13th.

7,223. "Control gear for electric starters for internal-combustion engines." E. Aron & E. Hill. May 13th.

7,239. "Electric switches." R. W. Bill. May 14th.

7,244. "Means for starting electric motors." G. A. Yarwood. May 14th. (Complete.)

7,263. "Apparatus for pneumatic conveying of solids." British Thomson-Houston Co., Ltd. May 14th. (General Electric Co., United States.)

7,269. "Apparatus for the calculation of mathematical problems arising in the transmission of electric power." W. D. Reid and Callender's Cable and Construction Co., Ltd. May 14th.

7,270. "Electrical measuring instruments operating on the Ferraris or induction principle." E. Fawssett. May 14th. (Complete.)

7,271. "Improvements in electric meters for the purpose of compensating for temperature variation." E. Fawssett. May 14th. (Complete.)

7,280. "Switches." V. Breeze and Allen, West & Co., Ltd. May 14th.

7,283. "Means for employing the exhaust heat of thermo-piles for heating purposes." J. Marschall. May 14th. (Divided application on 6,102/14, March 10th.) (Complete.)

7,297. "Electric lamps." E. P. Morriss. May 15th.

7,304. "Combined formers and heaters for electric radiators and the like." G. Bourne. May 15th.

7,308. "Electric switches." G. Webb. May 15th.

7,311. "Combined interruptor and rectifier for the production of unidirectional high-tension impulses of large capacity as used for X-ray work." A. C. Gunstone. May 15th.

7,316. "Means of controlling power apparatus driven by internal-combustion engines." Thomas Transmission, Ltd., & J. G. P. Thomas. May 15th. (Addition to 2,245/15.)

7,320. "Refining steel by electrical means." S. F. Barclay. May 15th.

7,324. "Ships' stokehold and analogous telegraphic apparatus." W. Chadburn & Chadburn's (Ship) Telegraph Co., Ltd. May 15th.

7,341. "Method of, and apparatus for, measuring electric current." Landis and Gyr Akt. Ges. May 15th. (Convention date, May 18th, 1914, Germany.) (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1913.

24,219. Dynamo-electric Machines for Lighting Vehicles. G. Inrig and Inrig, Ltd. October 25th. (April 27th, 1914.)

1914.

2,323. Electric Arc Incandescent Lamps. E. A. Gimingham. January 28th.

4,220. Support for the Heating Conductor of Thermic Telephones, and a Method for its Manufacture. P. de Lange & O. Fischer. February 18th. (September 8th, 1913 Addition to 4,184/14.)

8,842. Electric Cables. W. F. Price & Callender's Cable and Construction Co. April 7th.

9,558. Electric Switches. J. H. Tucker & J. A. Crabtree. April 17th. (Cognate application 21,175/14.)

10,015. Electric Clocks. J. H. Parsons & A. E. J. Ball. April 23rd.

10,504. Electric Relay. W. R. Sykes Interlocking Signal Co. & R. W. Tarrant. April 28th

10,531. Electric Motor Control Systems. British Thomson-Houston Co. (General Electric Co.). April 28th

10,533. Alternating-current Track Signalling. B. H. Peter. April 28th.

10,534. Electrically-operated Point or Signal Actuating Mechanism. B. H. Peter. April 28th.

10,549. Relays connected with Electric Signalling in Mines and the like. H. Davies & Railing April 29th.

10,716. Printing Telegraph Receivers. A. F. Dixon. April 30th. (October 14th, 1913.)

10,775. Telegraph Transmitting Apparatus. S. Lyle. May 1st.

10,807. Selective Signalling Systems for Party Lines. Western Electric Co. (F. T. Woodward acting for Western Electric Co.). May 1st.